NMG
Geotechnical, Inc.

March 25, 2011

Project No. 10028-01

To: Shea Homes
1250 Corona Pointe Court, Suite 600
Corona, California 92879

Attention: Mr. John Danvers

Subject: Geotechnical Review of Revised Tentative Tract 16466 Map, Baker Ranch, Lake Forest, California

In accordance with your authorization, NMG Geotechnical, Inc. (NMG) has performed a geotechnical review of the revised Tentative Tract 16466 Map for the Baker Ranch property located in northwestern Lake Forest, California (Figure 1). The site is approximately 387 acres in size and is located west of Bake Parkway and south of SR 241. The site is currently accessed from Commercentre Drive via Bake Parkway.

The primary purpose of NMG's work was three-fold:

1. Compile and consolidate pertinent geotechnical data from multiple past and current sources to be used as the basis for evaluating the planned development and for use in future phases of the project,
2. Review the most current tentative tract map in light of the compiled data to update geotechnical analyses of remedial measures and recommendations for grading and construction,
3. Prepare a current report suitable for tentative tract use and for submittal to the City of Lake Forest.

Because the prior geotechnical consultant for Baker Ranch, Pacific Soil Engineering, is no longer involved in the project, NMG's role included reviewing their data as well as consulting with former staff to provide some continuity with more recent work such as that associated with the extension of Alton Parkway (where NMG is serving as a second party reviewer for the entire project).

The revised tentative tract map, prepared by Hunsaker and Associates and received by NMG on February 16, 2011, was reviewed in light of the geotechnical conditions at the site. In this report we have included the prior geotechnical information, including boring and trench logs, CPT soundings and laboratory testing. New work by NMG included:

- Providing updated seismic data and seismic design parameters,
- Evaluation of recent geologic conditions exposed during grading for Alton Parkway,

- Preliminary analysis of the slope and storm drain system along the active Borrego Wash, and,
- Updating remedial grading and other design parameters.

This report presents our updated findings, conclusions, and recommendations for the proposed grading and development.

Based on our study, the proposed grading is considered geotechnically feasibly, provided the recommendations of this report are implemented during design, grading, and construction. Additional geotechnical services, including supplemental exploration and testing, will be necessary when the 40-scale grading plans are prepared. Primary areas that we recommend be further evaluated at that time include:

1. Settlement potentials due to deeper fills,
2. Three areas at the project perimeter identified by a prior consultant as "restricted use" areas due to partial remedial removals,
3. Measures needed to properly tie the project into on-going grading of Alton Parkway, and
4. Liquefaction potential along Borrego Wash.

If you have any questions regarding this report, please contact our office. We appreciate the opportunity to provide our services.

Respectfully submitted,

NMG GEOTECHNICAL, INC.

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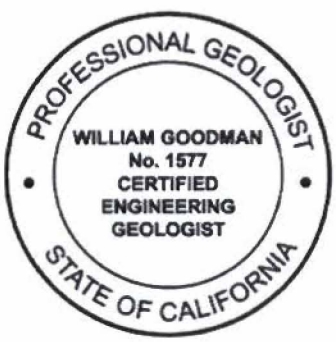

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1.0 INTRODUCTION

1.1 Introduction and Purpose

NMG Geotechnical, Inc. (NMG) has reviewed the revised tentative tract plan for the proposed Baker Ranch Property, Tentative Tract Map 16466, in the City of Lake Forest, California. A previous tentative tract plan was reviewed by Pacific Soils Engineering, Inc (PSE, 2002). The purpose of this study was to evaluate the revised planned grading in light of the geotechnical conditions at the site in order to provide updated remedial recommendations for rough grading for the future residential and commercial development. The new tentative tract plan, prepared by Hunsaker & Associates, received by NMG on February 16, 2011 was reviewed for this study and was used as the base map for the 100-scale Geotechnical Map in this report (Plates 1 and 2).

1.2 Scope of Work

The scope of work for this study included the following tasks:

- **Background Research:** Review of available geotechnical reports and maps and compilation of data onto the revised tentative tract grading plan. Review of stereoscopic aerial photographs dating back to the 1950s was also performed. References and aerial photos reviewed are listed in Appendix A.
- **Site Reconnaissance:** Site reconnaissance to review the existing geotechnical conditions and the conditions of the recent grading around the site.
- **Plan Review and Geotechnical Analysis:** Compilation of data from the prior investigations at and adjacent to the site, with new data related to the investigation and grading of Alton Parkway. Geologic cross-sections were prepared based on the compiled data and the updated grading profiles. This data is presented on the Geotechnical Map (Plates 1 and 2) and Cross-Sections A-A', B-B' and C-C' (Plate 3). The new tentative tract map was reviewed in light of the collected data. Analysis was performed to provide updated discussions regarding remedial grading measures including slope stabilization and a discussion of remedial removals. Geotechnical analysis also included a preliminary review of liquefaction, settlement evaluation, slope stability, and a preliminary estimation of earthwork shrinkage and bulking.
- **Report Preparation:** Preparation of this geotechnical report with the accompanying illustrations and appendices. This report summarizes our updated findings, conclusions, and recommendations for the planned grading and provides preliminary design information for the future site development.

1.3 Site Location and Conditions

The approximately 387 ± acre site is located in the city of Lake Forest, adjacent to the former El Toro Marine Base and southwest of the Foothill Transportation Corridor (Figure 1). Tentative Tract 16466 encompasses the majority of a parcel known as Baker Ranch and a small portion of Foothill Ranch (PA 16). The Pacific Commercentre development forms the majority of the

subject site's southern boundary with Bake Parkway and Commercentre Drive. A small recreational vehicle storage lot is also located along a portion of this southern boundary. A portion of Tentative Tract Map 15753 defines the eastern project boundary along with an existing Los Aliso Water District tank site. This portion of Tentative Tract 15753 has been recently developed. Foothill Ranch property, specifically Planning Area 15, is located along the project's northern and northeastern boundary along with the Foothill Transportation Corridor (FTC). The entire western boundary to the property is occupied by former El Toro Marine Base.

The site is accessible through the present terminus of Commercentre and Baffin Bay drives, the future intersection of Dimension Drive and Alton Parkway, or via recently graded dirt roads off of Bake and Alton Parkways. Within Tentative Tract 16466, paved and unpaved roads associated with the site's past and current agricultural use and previous grading, provide access onsite.

The project is within the foothills of the Santa Ana Mountains. It consists of moderately to gently sloping hillside terrain, with the gently sloping Borrego Wash and elevated terrace plain along the northwest edge of the site. Generally, the hillside slopes range from 4H:1V to as steep as 1.5H:1V within and adjacent to the proposed development area. The total topographic relief within the project site is nearly 290 feet, ranging from a high elevation of 860 feet in the northeastern portion of the site to a low elevation of 570 feet in the southwestern portion of the site.

There are many man-made features within the site, the majority of which are associated with past citrus farming operations and current nursery activities. These features include two ranch houses, greenhouses, a maintenance yard, and the nursery operations office. There is an extensive dirt road network throughout the site and some outlet electric lines. The current nursery operation is located on the Borrego terrace on the site's northwestern boundary. Irrigation systems including pumps, lines, and windmills are present throughout the parcel. Numerous fences and gates dissect the parcel. We understand that the present nursery activities will continue until development commences.

Two Los Alisos Water District above-ground reservoir tanks are present adjacent to the northeastern boundary of the site and associated water lines cross the parcel. A storm drain was installed within a previously proposed alignment of Dimension Drive. The currently proposed alignment of Dimension Drive is significantly different from the previous alignment.

Natural vegetation across the site consists of chaparral grasses, infrequent oak trees and scrub brush. The eucalyptus are the dominate trees at the site.

1.4 Site Historical Conditions

Historical stereographic aerial photographs dating from 1952 through 2009 were reviewed to determine past uses and conditions at the site. The following are the major highlights of this aerial photographic review based upon the photographs referenced in appendix A.

- Up to 1952, the site appears relatively untouched by human activities except for a few minor dirt roads that cross the site. The Borrego Wash's active channel consists of a braided stream

that randomly wanders across the flood plain. The hills are covered with grasses, light brush and a few trees. The site remains in a similar condition throughout the 1950s. Sometime around 1959, the northern border of the site was defined by an excavation that may have been for a fence line or may have been for a waterline or other utility.

- By 1965, the northwestern portion of the site was being prepared for a citrus orchard. These activities consisted of grading the active channel of the Borrego to match the rest of the flood plain. To do this, a narrow and straight channel was excavated along the northwestern boundary with the El Toro Marine base. A row of eucalyptus trees was also planted along this boundary on the northwestern side of the channel. The property line to the north of the site was also defined by an excavation that may have been a channel to control water runoff from adjacent properties. In 1965 the citrus trees were newly planted. The disturbed area was limited primarily to the Borrego flood plain.

- Sometime between 1965 and 1967, two houses were constructed within the site on knolls adjacent to the plain. The citrus orchards had expanded to fill in most of the canyon areas and the Borrego Plain. They appeared to be large enough to produce fruit. The recently excavated channel along the northwestern property line appeared to be the same as in 1965.

- Throughout the 1970s, the citrus orchards appeared to be in full operation with little or no changes. The two farm houses had a few additional features, such as trees and sheds. The various windrows of eucalyptus trees had matured to form wind blocks. The active channel along the northwestern property and the parallel row of trees remained consistent with no apparent erosion.

- In 1980, one of the two IRWD reservoirs (steel water tanks) was constructed in the northeastern corner of the site. A house had been near this offsite area since the late 1960s. Up until 1988 the condition of the remainder of the site remained relatively unchanged. The orchard appeared to be active and well maintained, and the active Borrego channel was still along the northwestern border. In 1988, a second IRWD above-ground reservoir was constructed adjacent to the first one. In the southeastern corner of the site there appeared to be a series of terraces where light crops were being cultivated. There was also a square building or shed in this area.

- The 1990s brought significant changes to the entire Lake Forest and Foothill Ranch area to the north. By 1992, Bake Parkway and the area on the southeast border had been graded. Foothill Ranch to the north of the future toll road had been mostly graded and some homes were built and occupied. Most of Baker Ranch was occupied by the same orchard operation and the Borrego channel was still a narrow ditch along the northwestern boundary with a row of parallel eucalyptus trees. The toll road to the north started construction in, or prior to, 1992 and, by early 1993, was mostly graded, although not completed. Approximately half of the homes in Foothill Ranch had been constructed and the commercial and residential projects immediately north of the toll road were being graded. Grading of the toll road created a channel beneath the road that collected the upstream waters and funneled them to the northwestern corner of the property. A trapezoidal debris basin, which was present in early 1992 in this area, was gone in 1993. In early 1993 the active Borrego channel appears to have been widened by erosion, including the loss of many eucalyptus trees. A plume of new sand

can be observed to have been recently deposited just beyond the property line in the southwest corner.

- Throughout the 1990s the development of Foothill Ranch properties to the north and Lake Forest properties to the east and southeast continued. The citrus orchard operation also continued during this time period until approximately 1997, when the trees were removed in the Borrego Plain and this area was converted to a nursery operation. A compost operation was also initiated at the southwest corner of the property. The Borrego channel continued to widen throughout the 1990s. By 1999, most of the eucalyptus trees along the southwestern border were no longer in place due to bank erosion, and erosion of the channel wall increased towards the southeast.

- From 2000 to present, the most significant change to the property was grading in the eastern portion within former named Parcels 1 and 2. In addition a formerly planned alignment of Dimension Drive was also graded and a storm drain installed. However, no other structures were constructed after the grading was completed. The nursery operation has continued till the present day, but the orchards have been removed and the composting operation has also been abandoned. The active Borrego channel is now up to 30 feet in depth, below the plain, and has widened from less than 20 feet wide (1959 to 1992) to greater than 125 feet wide after the winter storms this year (2011).

1.5 Previous Geotechnical Investigations and Grading

NMG understands that the project site has been the subject of various geotechnical studies, and construction activities that were monitored by many different geotechnical consultants. Appendix A includes references that documented these past construction activities and the geotechnical investigations. However, NMG has not obtained or been provided with many of these reports. The following is NMG's current understanding of this geotechnical and grading history.

- In 2010, Hushmand and Associates (HA) conducted a geotechnical investigation of the proposed alignment of Alton Parkway through the Baker Ranch property. In late 2010 grading began on this roadway and is currently ongoing. Grading is proposed to include remedial removals, subdrain installation, stabilization of perimeter slopes, and construction of several utilities within the roadway alignment. HA is the consultant of record for this grading from the City of Lake Forest and NMG is providing a second-party review of the grading operations. Grading aspects of the roadway are anticipated to be completed in 2011. Four borings were recently completed as part of rough grading of the road. The location and geologic information related to these excavations are shown on the geologic map and cross-sections (Plates 1 through 3); however the boring logs are not included in the appendices.

- Kleinfelder (2009) conducted a geotechnical review of the portion of Alton Parkway that extends from Commercentre Drive to the southwest of Baker Ranch. The grading of this portion of the roadway also commenced in late 2010 with Kleinfelder as the consultant of record. This grading and utility construction project is anticipated to be completed in early 2012. This project includes construction of the intersection of Commercentre and Alton Parkway which is within the Baker Ranch property boundary.

- Baker Ranch was the subject of a preliminary geotechnical investigation and tentative tract map review by PSE (2002) addressing a prior development plan. That study forms the primary database for this study. Site-specific boring and trench logs, and laboratory testing results conducted for that study are included in Appendices B and C of this report. The PSE (2002) study used information gleaned from many previous PSE reports. Boring and trench logs and laboratory test results from those studies are also included in the appendices. Boring and trench logs and laboratory tests results are separated in the appendices based upon the date that they were performed. Prior to PSE's 2002 study, several other geotechnical investigations and grading operations have been conducted onsite and on surrounding properties.

- In 2001 a portion of the site (referred to as Phases 1 and 2 by PSE), along the southern and eastern perimeter and extending into the interior, was rough graded under the geotechnical observation and testing of PSE (2001a and 2001b). The grading resulted in large superpads, but no structures were constructed except a storm drain that was installed in a previously proposed alignment of Dimension Drive.

- PSE was the geotechnical consultant during three different grading operations that have been conducted adjacent to the subject site's northeast boundary on Foothill Ranch Property. The grading associated with Planning Area 15 of Foothill Ranch was reported in PSE (1994). The grading associated with Planning Area 16 of Foothill Ranch (PSE, 1998a) is now a portion of the subject tentative tract. The grading of the extension of Alton Parkway and Town Center Drive into Baker Ranch was also completed in 1998 (PSE, 1998b). Limits of engineered fill and buried geologic contacts shown on the accompanying Plates 1 and 2 are based on data presented in the referenced PSE (2002) report.

- According to PSE (2002), Harrington Geotechnical Engineering, Inc. conducted geotechnical studies associated with the development of the easterly adjacent tentative tract map. The grading of Tract 15753 was completed under the observation and testing of Harrington Geotechnical Engineering, Inc.

- Portions of Baker Ranch were developed for a temporary recreational vehicle storage facility. Stoney-Miller Consultants (SMC) was the geotechnical consultant for that work which was completed in several phases.

- Engineered fill associated with the neighboring Pacific Commercentre Project was placed onsite under the observation of Stoney-Miller Consultants, Inc., with second party observations by PSE.

- There are three areas shown on PSE's 2002 plans that were designated for restricted use because it was reported that remedial removals of unsuitable materials could not be performed to competent materials in these areas. In general the removals were reported to be restricted due to developments immediately adjacent to the site. According to PSE (2002) therefore, there is a potential for significant settlement and or collapse within these zones. Actual limits and depths of unsuitable material were not presented in the PSE (2002) report.

- In addition to the above private investigations, there are also several published geologic reports and maps by the State that were reviewed for this study (Appendix A).

1.6 Proposed Development

The proposed development consists of 652 single-family and multi-family residential lots, one retail lot, 13 private parks, and 106 lettered lots, which will be used for open space, trails, water-quality control basins and/or flood control. The main access for the development will be from future Alton Parkway (currently under construction) and existing Bake Parkway. Other access roads include Rancho Parkway which will be extended from its present terminus to connect with Town Center. Existing Baffin Bay Drive and Dimension Drive will also be extended to service the interior of the project.

The proposed preliminary grading will involve design cuts of up to approximately 85+ feet deep and fills up to 65+ feet thick. Design cut and fill slopes are shown along the perimeter of the site and within the interior of the hillside development; design cut slopes are up to approximately 35 feet high and design fill slopes are up to approximately 58 feet high. A combined slope that ascends from the Borrego Wash will ultimately be a fill slope that is up to 55 feet in height and is a combination of a lower 3:1 and 2:1 slope portion, and an upper 2:1 slope portion that is separated by a minimum 40-foot-wide mid-slope trail. A large storm drain box structure is located beneath this mid-slope bench. It is designed to channel storm water flow out of the current Borrego Wash and allow only low daily flow into the future natural wash area. Specific plans for this structure were not available for review at the time of this report.

2.0 GEOTECHNICAL FINDINGS

2.1 Regional Geologic Setting

The project site is located within the Peninsular Range geomorphic province at the southeastern margins of the middle to upper Miocene-age Los Angeles Basin. It lies in the southwestern foothills of the Santa Ana Mountains. To the north, this province is bounded by the Whittier-Elsinore fault zone (located 8 miles north of the site), and by the Newport-Inglewood fault zone to the south (located 13 miles south of the site).

2.2 Earth Units

The site is primarily underlain by bedrock of the Tertiary Capistrano Formation (Oso Member) with minor portions in the southwest corner underlain by bedrock of the Monterey Formation. Quaternary terrace deposits cap the lower lying ridges and Quaternary alluvium and colluvium have in-filled the ancient channels. Existing engineered fill and undocumented fill are present throughout the site. These earth units are depicted on the accompanying geotechnical maps (Plates 1 and 2).

Monterey Formation (Map Symbol - Tm): This bedrock material was deposited in a shallow marine environment during the Tertiary Period (about 5 to 15 million years ago). It was encountered in the far southwestern corner of the project exposed in Boring B-13 and Trench T-40. In these excavations, it is described as tan to buff colored, well bedded sandstone and siltstone. The bedrock is described as medium dense to dense, and varying from cemented to friable. According to PSE's (2002) mapping, the Monterey is in fault contact with the overlying Capistrano Formation.

Capistrano Formation, Oso Member (Map Symbol - Tco): This bedrock was also deposited in a shallow marine environment during the Tertiary Period approximately 1.5 to 5 million years ago. It underlies nearly the entire site except where a minor portion of the site is underlain by the Monterey Formation. In the excavations where it was encountered it is described as a white to light grey, sandstone to silty sandstone, dense to very dense, locally friable to locally well cemented. A few borings encountered mica rich clay, or Bentonitic clay beds, however, it is generally described as massive.

Quaternary Terrace Deposits (Map Symbol - Qt): Terrace deposits are present along intermediate to lower ridges within the western portions of the parcel. These deposits represent the dissected remnants of the former flood plain/stream bed, produced during an earlier stage of erosion and deposition. The terrace deposits are typically tan/reddish brown, silty/clayey sands with occasional pebble and cobble lenses. The material ranges from loose near the surface to dense at depth and dry to moist. Much of the terrace deposits were derived from the bedrock units in the Santa Ana Mountains to the northeast.

Alluvium/Colluvium Undifferentiated (Map Symbol – Qac): Quaternary-age alluvial/ colluvial deposits are found in the major drainages and low-lying areas within the site. Due to similar engineering characteristics and for ease of discussion, alluvium and colluvium were

undifferentiated by PSE. These sediments originated from the surrounding bedrock and terrace deposits units and have been transported by water and/or gravity. Due to the consistent character of the bedrock unit, the alluvium/colluvium is fairly uniform and consists of poorly graded sand, silty sand, and clayey sand. Alluvial deposits within the Borrego flood plain reach depths in excess of 70 feet as indicated in the boring logs (Appendix B).

Artificial Fill (Map symbol – Afu and Afe): Areas of undocumented artificial fill **(Afu)** occur across the site, generally associated with past agricultural activities, including deep plow zones, access roads, in-filled old drainage channels, and irrigation/water lines. During development of the citrus grove, the active channel of the Borrego Wash was filled-in and redirected to the northwestern boundary. The depth or nature of the fill in this prior channel is uncertain. However, in general, these and other fills are likely derived from onsite soils and bedrock materials and consist of loosely compacted silty to clayey sands, with varying amounts of debris. These fill material were not tested nor were unsuitable earth materials below these fills documented and are subject to removal.

As discussed previously, there are several areas of existing engineered compacted fills **(Afe)** that are a result of previous grading at or adjacent to the site. These fills are reportedly primarily derived from onsite native soils and/or bedrock. The fill materials are reported to consist of fine sandy silt and silty sand, and clayey sands that were compacted to a minimum of 90 percent relative compaction. These fills have been in place for approximately 10 years to over 20 years. We anticipate that the upper 1 to 7 feet or more of these existing fills have weathered and or dried out and no longer meet the minimum compaction criteria. The locations of these engineered fills are based on PSE's (2002) report, which did not include the elevation or depth of removal bottoms prior to fill placement. The maps from geotechnical reports that may contain this information were unavailable to review at this time. However, the text portions of these reports were available and the reports are listed in Appendix A.

2.3 Geologic Structure and Faulting

The general overall geologic structure within the site consists of a homoclinal sequence where bedding is generally dipping to the southwest. Local variations are apparent due to cross bedding and paleo-erosional surfaces. Morton and Miller (1976 and 1981) mapped the contact between the Monterey Formation and Capistrano Formation as a fault. PSE's reports indicate that other geotechnical consultants have postulated that the contact is depositional, however apparently the contact has not been observed in any excavations. This fault (if present) is considered to be inactive.

The alluvium and terrace deposits are generally flat lying, with a gentle dip toward the southwest (down-gradient).

2.4 Seismicity and Seismic Hazard Zones

Faulting: The site is not located within a fault-rupture hazard zone as defined by the Alquist-Priolo Special Studies Zones Act (CDMG, 1999). There are no known major or active faults mapped within the proposed development area, and no evidence of active faulting was observed

during prior work at the site (Appendix A). Past investigations and geologic mapping during rough grading at the site and adjacent areas did not encounter geomorphic expressions or visible lineaments associated with active faulting at the site. Therefore, the potential for primary ground rupture at the site is considered slight to nil.

Using the USGS computer program (2002, updated 2008) and the site coordinates of 33.6743 degrees north latitude and 117.6793 degrees longitude, the closest major active faults to the site are the San Joaquin Hills Blind Thrust located 6.5 km southwest of the site, the Newport-Inglewood Fault (offshore) located approximately 21.3 km to the southwest of the site and the Whittier-Elsinore Fault located approximately 17.6 km north of the site.

Seismicity: Properties in southern California are subject to seismic hazards of varying degrees depending upon the proximity, degree of activity, and capability of nearby faults. These hazards can be primary (i.e., directly related to the energy release of an earthquake such as surface rupture and ground shaking) or secondary (i.e., related to the effect of earthquake energy on the physical world which can cause phenomena such as liquefaction and ground lurching). Since there are no known major or seismically active faults mapped at the site, the potential for primary ground rupture is considered slight to nil. The primary seismic hazard for this site is ground shaking due to a future earthquake on one of the major regional active faults, such as the San Joaquin Hills Blind Thrust, Newport-Inglewood, Whittier-Elsinore, San Andreas, and San Jacinto faults.

The seismic design parameters presented in the recommendations section of this report are based on the 2010 California Building Code (CBC), and were obtained for the site utilizing the computer programs Seismic Hazard Curves and Uniform Hazard Response Spectra version 5.0.8-1 (USGS, 2007) and the 2002 Interactive Deaggregations (USGS, 2002 updated 2008).

The maximum moment magnitude for the Controlling Fault is 6.6 MW, which would be generated from the San Joaquin Hills Blind Thrust Fault.

Secondary Seismic Hazards: There are seismic hazard zones within the site based on recent mapping of the State (CDMG, 2001) for potential liquefaction (Figure 1). The potential liquefaction hazard is addressed in Section 2.8. Secondary seismic hazards such as tsunami and seiche need not be considered, as the site is located away from the ocean or confined bodies of water.

2.5 Surface Water and Groundwater

Surface water flows year round within the northernmost portion of the Borrego Wash. The annual flow is from an offsite storm drain that connects to the residential and commercial developments to the north of the site. The northern most portion of the active wash is underlain by shallow bedrock. In this area water flows at the surface year round. Further downstream the wash is underlain by relatively permeable alluvium and the water disappears underground except during the winter rainy season.

Groundwater was observed in many of the borings and other excavations. This groundwater is believed to be perched within the alluvial/colluvial and weathered bedrock materials above the contact with the underlying unweathered bedrock. Because of the different years and different times of year that exploratory excavations were made, the groundwater level below the Borrego flood plain and wash appears to fluctuate. However, analysis of the more recent excavations indicates that the groundwater has most likely stabilized and only fluctuates a few feet between the summer and winter months. It is NMG's opinion that this relative consistency is because there is a constant source of water, via the storm drains, from developments to the north of the site. In general, in the area of the flood plain and wash, the groundwater is anticipated to be within 5 to 10 feet below the level of the active Borrego Wash, with the depth to groundwater from ground surface increasing to the southwest. It is anticipated that this groundwater level also affects the level of groundwater in the larger side canyons that connect into the Borrego Wash and Plain.

Recent borings related to the proposed construction of Alton Parkway (HAI, 2010, and unpublished in-grading borings, 2011) have indicated groundwater exists near the bottom of the alluvial deposits within the ancient buried canyon areas away from Borrego Wash. The groundwater condition may also be affected by several subdrains that were installed as part of previous grading operations that have not been properly connected to an outlet structure.

2.6 Mass Movements

There are local small areas of surficial erosion and slope creep in the steeper terrain at the heads of swales. There are no landslides mapped at the site, and landslides were not encountered during previous investigations or grading at the site (PSE, 2002). Also, based on the seismic hazard mapping by the State (CDMG, 2001), areas of potential seismically induced landslides are not mapped within the subject site (Figure 1).

2.7 Slope Stability

There are planned cut slopes of up to approximately 35 feet high within the site, and there are fill slopes of up to approximately 58 feet high. Most of the designed slopes however, are less than 35 feet in height. The highest slopes are adjacent to future Alton Parkway and are up to 58 feet in height. The slopes that ascends up from the active Borrego Wash, has a total height of up to 55 feet, but has a mid-slope bench which is generally over 40 feet in width. Other slopes within the development are generally less than 30 feet in height.

For this report, we analyzed three general slope cases for slope stability (all 2:1 slope ratio): 1) the highest cut slope (25 feet) with out-of-slope clay beds dipping 5 to 15 degrees, 2) the highest cut slope (35 feet) with neutral (flat) bedding, and 3) the highest fill slope (58 feet). For Case 1 we assumed a 3-foot-deep and 15-foot-wide stabilization fill key.

Earth strength parameters for use in the slope stability analyses were derived from data and reports by Hushmand (2010) and PSE (2002). The parameters along with a description of the software used, methodology, and results of our analyses are included in Appendix D.

Our analyses show that the planned cut slopes should be grossly stable with factors of safety of 1.5 and 1.1 or greater for static and seismic cases, respectively.

2.8 Liquefaction Potential

Liquefaction is a phenomenon in which earthquake-induced cyclic stresses generate excess pore water pressure in low density (loose), saturated sandy soils and soft silts below the water table. This causes a loss of shear strength and, in many cases, ground settlement. For liquefaction to occur, all of the following conditions must be present:

- There must be severe ground shaking, such as occurs during a strong earthquake.
- The soil material must be saturated or nearly saturated (generally below the water table).
- The corrected normalized standard penetration test (SPT) blow counts (N_1) or the CPT tip resistance (Q) must be relatively low.
- The soil material must be granular (usually sands or silts) with, at most, only low plasticity. Clayey soils and silts of relatively high plasticity and dense sands are generally not subject to liquefaction.

Based on seismic hazard mapping by the State, most of the Borrego Wash and adjacent flood plain is mapped within areas of potential liquefaction (Figure 1). Review of the data gathered during previous subsurface investigation indicates that the potential for liquefaction at the site may be low to moderate due to the recorded blow counts, depth of the groundwater table, and the alluvial soil composition. Additional exploration, liquefaction evaluation, and lateral spreading potential is recommended at the 40-scale grading plan review stage.

2.9 Settlement

Based upon previous subsurface exploration, laboratory testing and analysis, and review of prior data, the alluvium, colluvium, undocumented fill, weathered engineered fill, weathered terrace deposits, and weathered bedrock have low densities. Portions of these near-surface unsuitable soils are prone to significant collapse and/or consolidation and have poor bearing properties. The thickness of this unsuitable soil zone varies from approximately 2 to 40 feet across the site. Below these surface materials the un-weathered terrace deposits, bedrock, and un-weathered engineered fill materials have favorable properties with respect to bearing capacity and settlement potential.

In many of the areas where unsuitable earth materials exist, new fill up to 40 feet in depth are being proposed. The amount of potential settlement can vary significantly over the site due to variations in subsurface conditions and depths of planned cuts and fills. In conducting preliminary settlement analyses, we have assumed that remedial removals will be implemented to remove the unsuitable soils to bedrock, terrace deposits, and/or existing engineered fill, except within the Borrego Wash, Borrego Plain and larger side canyons, where saturated alluvium and colluvium is anticipated to be left in place.

The total thickness of designed fills and fills as a result of remedial removals may locally exceed 70 feet in depth. In addition, existing fills are locally greater than 50 feet in depth (PSE, 2002). Beneath lot 418 the future total fill thickness (existing plus future) will be greater than 90 feet in depth. Along the southern perimeter, additional fill is planned that would be placed over existing artificial fill that was placed over saturated alluvial deposits. While the existing fill in this area is nearly 20 years old, it is anticipated that this additional fill placement will result in further settlement.

Portions of Alton Parkway will be underlain by alluvium/colluvium and up to 50 feet of engineered fill. These areas, where potentially compressible materials will be left in place, are also planned for up to 50 feet of fill as part of tentative tract grading. Therefore, significant settlement may occur along the perimeter of the road. The potential for settlement should be evaluated once the roadway is graded and based on actual conditions.

From the properties of onsite earth materials and the anticipated new fill loads, we anticipate that maximum total settlements at the site will be on the order of multiple inches over a period of 25 years, but within typically accepted tolerances for the proposed development, provided some time elapses following the completion of grading. Maximum settlement waiting periods where some amount of the primary settlement is allowed to take place are generally expected to be on the order of 1 to 6 months or more, depending on the amount of new fill and the earth materials beneath.

2.10 Earthwork Shrinkage/Bulking and Subsidence

The loss or gain of volume (shrinkage or bulking, respectively) of excavated natural materials and re-compaction as fill, varies according to earth material type and location. This volume change is represented as a percentage shrinkage (volume loss) and as a percentage bulking (volume gain) after re-compaction of a unit volume of cut in this same material in its natural state. The onsite materials will have varying shrinkage or bulking characteristics. The following table presents the projected range of values for each type of material:

Earth Unit	*Approximate Percent Shrinkage/Bulking*
Artificial Fill, alluvium/colluvium	5 to 15 percent shrinkage
Terrace Deposits	0 to 5 percent shrinkage
Bedrock Units	0 to 4 percent bulking

Ground subsidence at the site is estimated to be on the order of 0.1 foot across the site.

2.11 Existing Utilities

There are many agricultural irrigation pipelines that cross the property. There are also several existing buried and above ground utilities that service the existing houses at the site. We assume that existing septic systems and cesspools may exist near the houses and possibly near other buildings/sheds onsite.

A 36-inch storm drain and several laterals were installed as part of a previously anticipated alignment of Dimension Drive. The new alignment of Dimension Drive is different than was graded in 2001 (PSE, 2001b). Therefore, this storm drain which was installed to drain dimension Drive will require abandonment (total removal) during future grading at the site.

Numerous other utilities have been installed along the perimeter of the project that will require tie-ins to the proposed project utilities. The tie-in locations may require geotechnical evaluation, for trench stability and/or settlement of the utilities, especially where the utilities are deeper than approximately 5 feet. Utilities associated with prior land use are to be removed during grading, as discussed in Section 3.2.1.

2.12 Rippability and Generation of Oversize Material

The rippability characteristics of bedrock depend upon the rock type, hardness, the depth of weathering, degree of fracturing, and the structure of the rock. The deepest cuts within the site are on the order of 85 feet, and with remedial grading, cuts may be up to 90 feet deep.

Borings excavated throughout the site using bucket augers and other forms of drilling were excavated to a maximum depth of 80 feet into the bedrock and earth material without refusal. The equipment used to excavate these borings typically cannot excavate, without coring, earth materials that are not rippable.

Based on prior explorations and grading within the site, the bedrock should be rippable with D-9 and D-10 bulldozers. Proper equipment selection and sound ripping techniques are important for effective earthwork operations. Deeper cuts will encounter local areas of cemented sandstone and siltstone which will be the most difficult to excavate and oversize rock will be generated (rocks greater than 12 inches in the maximum diameter). NMG anticipates that a moderate amount of oversize rock will be generated from localized cemented zones within the bedrock.

3.0 CONCLUSION AND PRELIMINARY RECOMMENDATIONS

3.1 General Conclusion and Recommendation

Based on our findings, the site is considered geotechnically feasible for the proposed residential and retail development, provided the recommendations of this report are implemented during grading and future design and construction. Our recommendations are considered minimum and may be superseded by more stringent requirements of others. The grading and construction should be performed in accordance with the City of Lake Forest Grading Code and the grading specifications provided in Appendix F, except as superseded below.

3.2 Remedial Grading

Substantial remedial removals are anticipated to bring the site to structural conditions as shown on the tentative tract map. Demolition of existing site improvements associated with prior land use will be required during remedial grading at the site. These improvements include existing utilities, residential structures, onsite sewage disposal structures, abandoned storm drain segments, drainage basins, etc. Depths of the demolition and remedial removals are provided below.

3.2.1 Demolition

Foundations associated with the existing residential structures, drainage devices, windmill, nursery buildings, temporary erosion-control devices, etc., shall be demolished and removed from the site during remedial grading. Demolition will include removal of existing nursery water pipelines, overhead electrical poles/lines and temporary drainage devices.

Based on our understanding, there are likely old septic systems for the residential structures at the site. There may be other septic system associated with the other existing structures as well. These septic systems are anticipated to be removed during grading.

3.2.2 Remedial Removals

Unsuitable earth materials should be removed prior to placement of proposed fill. Unsuitable materials at the site include topsoil, alluvium, colluvium, undocumented fills, weathered engineered fill, weathered terrace deposits, and weathered bedrock. Estimated removal depths vary significantly across the site.

Undocumented fills associated with farming operations, detention/desilting basins, the network of unpaved access roads, old drainage channel infill, and existing trench backfills should be removed prior to fill placement. Generally, these artificial fills range in depth from 3 to 10 feet in thickness.

Previously engineered fills are a minimum of 10 years old and have undergone significant erosion and weathering. It is anticipated that the weathering zone within these materials is approximately 1 to 7 feet in depth. This zone of weathering must be removed prior to further fill placement, and/or support of structures. The maps from previous geotechnical reports, which include previous remedial removal limits and bottom elevations, were unavailable at this time for review. Efforts should be made during geotechnical review of the planned 40-scale grading plans to obtain this information for future use. This will provide potential for a better evaluation of the remedial grading that is necessary to properly tie into the previous construction activities.

Unsaturated alluvial/colluvial material should be removed prior to fill placement. The unsaturated portion of these deposits are anticipated to range from several feet to up to 40 feet in depth across the site. Saturated alluvium/colluvium (having a minimum 85 percent degree of saturation) deposits are anticipated up to 40 feet in depth. These saturated deposits may be left in place, provided the settlement and time delay consequences are acceptable by the project owner.

The terrace deposits, which cap the lower to intermediate ridgelines at the site and the underlying bedrock deposits are weathered near the surface. This weathered zone, which is generally less than five feet in depth, requires removal prior to fill placement or if exposed at finish grades.

The ongoing grading of Alton Parkway through the project includes remedial removals that impact the proposed road alignment. These proposed removals are also intended to extend into the area of the proposed tentative tract grading such that removal of unsuitable material during tentative tract grading can be readily accomplished. This condition should be evaluated at the 40-scale plan review stage and based on actual conditions once the road grading is completed.

Estimated removals will be provided based on a more detailed 40-scale plan review and further explorations. Removal bottoms should expose competent material and should be evaluated and accepted by the geotechnical consultant. The removal bottoms should be scarified, moisture-conditioned and recompacted prior to placement of compacted fill unless the removal bottom consists of saturated material. Where removal bottoms expose saturated material, bridging with gravels, sands, or geofabric may sometimes be necessary for workability. These areas will need specific evaluation based on the actual conditions at the time of grading and the planned thickness of overlying fill.

3.3 General Earthwork and Grading

Prior to commencement of grading operations, deleterious material (including highly organic topsoil, vegetation, trash, unsuitable debris) should be cleared from the site and disposed of offsite. Numerous irrigation lines are anticipated that cross the site. These lines should be removed and the areas should be properly backfilled if determined to be below the removal bottom.

Grading and excavations should be performed in accordance with the City of Lake Forest Grading Code and the General Earthwork and Grading Specifications in Appendix F. Prior to placement of fill, removal bottoms should be scarified a minimum of 6 inches, moisture-conditioned as needed, and compacted to a minimum 90 percent relative compaction. Fill material should be placed in loose lifts no greater than 8 inches in thickness and compacted prior to placement of the next lift. Ground sloping greater than 5H:1V should be prepared by benching into firm, competent material as fill is placed. Relative compaction should be based upon ASTM Test Method D1557. Moisture content of fill soil should be over optimum moisture content. Consideration should be given to placing fill at higher moisture contents to facilitate the subgrade presoaking process under slabs-on-grade.

Native materials that are relatively free of deleterious material should be suitable for use as compacted fill. If import soils are required in order to achieve design grades, they should be evaluated by the geotechnical consultant prior to and during transport to the site to verify their suitability. Wet soils may require drying back prior to placement as fill.

Removal bottoms, fill keys, stabilization fill keys, canyon subdrains, backcuts, backdrains, and overexcavation lots should be surveyed prior to observation, mapping and acceptance by the geotechnical consultant.

3.4 Slope Stabilization

Slope stabilization measures in the form of stabilization fills are recommended during grading for all cut slopes. Keyway excavations should be mapped and evaluated by the geotechnical consultant to verify the anticipated geologic conditions. If the conditions are different than anticipated, the slope stability analysis should be checked and the remedial grading measures modified as necessary. The keys and excavations should be evaluated and accepted by the geotechnical consultant prior to placement of the subdrain and/or backfill. The keyway excavations should be provided with proper subdrainage in accordance with our standard details in Appendix F.

3.4.1 Proposed Slopes

The majority of the proposed cut slopes for the proposed project are less than 30 feet in height. These slopes are recommended to be stabilized using a stabilization fill. The key for stabilization fills should be a minimum of 15 feet in width and 3 feet in depth. Slopes that expose adverse bedding, and/or weak clay beds may require larger keys for stabilization and should be determined during the 40-scale plan review. Backcuts for the stabilization fills should be excavated at 1.5H:1V or flatter slope ratios depending on the height of the slope.

The reworked onsite soils are anticipated to provide adequate strength for the gross stability of the proposed fill slopes of up to approximately 58 feet in height at 2H:1V inclinations. A base fill key should be provided for these slopes. The depth of the key should be a minimum of 2 feet into competent earth material, at least 15 feet wide, and have a 2 percent tilt back into the slope.

Some of the onsite materials that will be used for fill are clean granular material with very little cohesion. It is recommended that the fill materials used for the outer 15 feet of any fill slope be constructed with earth materials that have some cohesive characteristics to help reduce the potential for erosion during storm events. If cohesive earth materials are not available, then finished slopes should be protected against erosion by using deeply and extensive rooted plants, spray-on protective coverings, and/or other special protective erosion control measures.

These fill slopes are anticipated to be stable as designed provided they are constructed in accordance with the details in our General Earthwork and Grading Specifications (Appendix F).

3.4.2 Temporary Stability

Temporary slopes will be created by the backcuts for the recommended stabilization fills as well as for remedial removals. Backcuts should be designed with a slope ratio of 1.5H:1V to 2H:1V and may be up to 50 feet in height. The actual stability of the backcuts will depend on many factors, including exposed earth materials, amount of unloading performed prior to backcut excavation, and amount of time the excavation remains exposed. Proper remedial measures should be provided to protect the adjacent properties in-place. Measures to mitigate potential backcut failure may include the following:

- The excavation bottoms should not be left open for long periods of time; the lower portions of the keys should be backfilled as soon as practical (i.e., backfilled prior to the weekend if possible).
- The backcut and front cut should be carefully excavated at the recommended slope angles and "on grade" to reduce oversteepened areas. Cutting areas at steeper angles may result in slope failure.
- The backcut and front cut should be "slope-boarded" on a routine basis so that the geotechnical consultant can map the slope carefully during excavation and help to notify the project team of critically unstable areas. This will also allow those working in the key to observe any active failures.
- If necessary, the keyways and remedial grading operations may need to be constructed in sections (on the order of 100 feet long); shorter sections may be necessary if backcut failures occur.

3.4.3 Natural Slopes

An ascending natural slope area is located in the northeast corner of the project, immediately adjacent to Lot 656. This slope is up to 95 feet height with slope ratios ranging from 1.6:1 to 3:1. This slope area is the head of a natural drainage and is expected to continue to erode during storm events. Therefore, there is a potential for debris flows or surficial failure. The slope is expected to be grossly stable. However, a debris basin with an impact wall should be constructed at the toe of slope.

There are several ascending natural slopes located along the western edge of the project immediately adjacent to the west side of Borrego Wash. The slope at the northwest corner is up to 90 feet high with slope ratios of 2:1 to 3:1. The slope at the southwest corner ranges from 30 to 40 feet high with slope ratios of 3:1 to 5:1. The slope along the majority of Borrego Wash ranges from 2:1 to near vertical. This condition is the result of active creek erosion. Although these slopes are grossly stable, erosion will continue to contribute sediment to Borrego Wash.

3.5 Rippability and Placement of Oversize Material

The bedrock at the site includes portions that are dense cemented sandstone that will be difficult to rip. We anticipate that the bedrock will be rippable, though, at times with difficulty (using D-9 and D-10 bulldozers) in the planned excavations (design cuts and remedial excavations less than 90 feet).

Local excavations within the bedrock cuts will produce oversize rock (greater than 12 inches in size) that will require special placement in the fill. Oversize rock may be placed in fills deeper than 10 feet, and a minimum of 2 feet below the deepest utilities within the streets. Placement of oversize material should be performed in accordance with our General Earthwork and Grading Specifications in Appendix F. Grading operations should be carefully planned so that the fills deeper than 10 feet can accept oversize rock from the cuts.

3.6 Lot and Street Capping/Overexcavation

The proposed grading is anticipated to expose cut and fill transitions at finish grade within many of the lots. The lots fully or partially exposing bedrock should be overexcavated to a minimum depth of 5 feet and replaced with compacted fill to provide a uniform fill cap over each lot. If hard bedrock is exposed at overexcavation grade that cannot be excavated with normal trenching equipment, additional overexcavation should be considered to two feet below the deepest utility line to facilitate future foundation construction and utility installation. Otherwise larger excavators and rock breaking equipment may be needed to install the utilities.

Deeper lot overexcavation/capping (up to 10 feet) may also be recommended during grading if the earth materials are very different on a lot, such as in areas where highly expansive clay beds are encountered in the sandstone.

The streets should be overexcavated a minimum of 2 feet below subgrade to provide a uniform fill cap. In addition, deeper street overexcavations should be considered due to the potential of encountering materials that may be difficult to excavate with a backhoe, and the potential for unstable sidewalls in the fractured and sometimes poorly cemented bedrock. It is suggested that the street areas in shallow fill/cut grading sections be overexcavated by 8 feet or to the invert of the deepest utility line, whichever is greater. The developer should establish the final determination for this requirement.

During the previously completed grading near Bake parkway, the footprints of previously proposed commercial buildings were overexcavated to a depth of 5 feet below the prior finish

grades and capped with 5 feet of compacted fill. It is now proposed to place fill on the order of 15 feet above existing grades. In order to prevent the creation of a "bird bath" condition, it is recommended that this area be overexcavated to eliminate this condition. Details for this area will be provided at the 40-scale level when building pad locations are defined.

3.7 Groundwater

The groundwater that is anticipated to exist once the site is graded should be primarily concentrated in the bottom of canyon removals where saturated alluvium/colluvium is anticipated to be left in place, and below the Borrego Wash and Plain, which is fed by daily flow from upstream developments. Also, transient groundwater is expected in the future to migrate along the fill-bedrock contact. Subdrains are planned for the canyon bottoms and the stabilization keys and backcuts to help control groundwater flow.

3.8 Subdrainage

During previous and ongoing grading operation for Alton Parkway many subdrains have been/will be installed in the canyon removal bottoms. During grading of Phases 1 and 2 in 2001 (PSE, 2001b), several canyon type subdrains were installed within the canyons located in the higher portions of the project. Some of these subdrains were not outlet into a permanent drainage structure. At three locations risers were attached to the lowest end of the subdrain in anticipation that these drains would be connected into future anticipated subdrains. The approximate location and elevation of these drains are shown on Plates 1 and 2. The grading for Alton Parkway is anticipated to be completed prior to grading the remainder of the site. This Alton Parkway grading will also result in several additional subdrains that will need to be extended up and down gradient when constructing the proposed project. A buttress subdrain was also constructed in 2001 that was anticipated to be tied into a future storm drain that was going to be installed within Dimension Drive. The design location of Dimension Drive has since changed significantly, therefore this subdrain will need to be further extended and tied into the storm drain that will be constructed in future "B" Street. The specific recommendations for tying into existing and future sudrains should be evaluated at the 40-scale grading plan review stage.

Canyon-type subdrains (9-cubic-feet-per-foot of gravel with a 6-inch, Schedule 40, perforated pipe wrapped in filter fabric) should be placed on the removal bottom of the canyons prior to placement of fill and provided with a suitable outlet. Where the canyons are wider, the need for additional subdrains should be evaluated by the geotechnical consultant during grading.

Backdrains (3 cubic feet per foot) should also be provided for the recommended stabilization fills at 20-foot-vertical intervals with outlets every 100 feet through the slope face. The details for subdrains and backdrain are included in our Earthwork and Grading Specifications (Appendix F).

3.9 Liquefaction Potential

Liquefaction and other potential ground effects associated with liquefaction such as settlement and lateral spreading should be further evaluated when the 40-scale grading plans are prepared.

Additional exploration and laboratory testing may be recommended at that time. The area of primary interest will be the Borrego Wash.

3.10 Settlement Potential

Recommended remedial removals (Section 3.2) are intended to remove the potentially collapsible and/or very compressible near-surface unsaturated alluvial material. The amount of settlement where saturated alluvium will be left in place will depend on the thickness of the alluvium and design fills and loading conditions. Along the very southern perimeter of the site additional fill is proposed to be placed over existing fill that was placed over left-in-place saturated alluvium.

We recommend that the deeper fill areas (greater than 40 feet) and areas where more than 10 feet of fill will be placed over relatively thick older fill and/or left-in-place alluvium be monitored for settlement with a combination of buried settlement plates and surface monuments. The location of these devices should be determined at the 40-scale grading plan review stage. Installation of the devices is typically the task of the geotechnical consultant during and at the completion of grading. Surveying of the devices at the time of installation and subsequent monitoring should be performed by a licensed surveyor.

Fills deeper than approximately 50 feet below finish grade should be compacted to a minimum of 93 percent relative compaction to reduce the amount and time related to long-term settlement.

The frequency of settlement monitoring (survey readings) will depend upon the grading and construction schedule and other factors, such as the timing of residential building and occupancy. Construction of structures should not commence until the geotechnical consultant has determined, from settlement monitoring, that remaining settlements are within acceptable limits for the intended improvements.

3.11 Seismic Design Parameters

The prior reports were prepared before implementation of the 2010 California Building Code, so the seismic design recommendations require an update. The seismic design criteria based on the 2010 CBC is as follows:

Selected Seismic Design Parameters from 2010 CBC	*Seismic Design Values*	*Reference*
Latitude	33.6743 North	
Longitude	117.6793 West	
Controlling Seismic Source	San Joaquin Hills Blind Thrust	USGS, 2008
Distance to the Controlling Seismic Source	4.2 Miles (6.5 km)	USGS, 2008
Site Class per Table 1613.5.2	D	USGS, 2010
Spectral Acceleration for Short Periods (Ss)	1.405 g	USGS, 2010
Spectral Accelerations for 1-Second Periods (S1)	0.501 g	USGS, 2010
Short-Period Site Coefficient, 0.2 s-period (F_a)	1.0	USGS, 2010
Long-Period Site Coefficient, 1.0 s-period (F_v)	1.5	USGS, 2010
Five-percent damped Design Spectral Response Acceleration at Short Periods (S_{DS}) from Equation 16-39 (Site Class D)	0.937 g	USGS, 2010
Five-Percent Damped Design Spectral Response Acceleration at 1-Second Period (S_{D1}) from Equation 16-40 (Site Class D)	0.501 g	USGS, 2010

3.12 Lateral Earth Pressures

Based on laboratory test results and our previous experience on similar projects, we recommend the following lateral earth pressures for native soils in drained conditions:

	Equivalent Fluid Pressure (psf/ft.)	
Conditions	*Level*	*2:1 Slope*
Active	40	65
At-Rest	60	85
Passive	350	130 (sloping down)

In addition to the above lateral forces due to retained earth, the influence of surcharge due to other loads such as adjacent footings, or lateral load acting on screen walls above the retaining wall, if any, should be considered during design of retaining walls.

To design an unrestrained retaining wall, such as a cantilever wall, the active earth pressure may be used. For a restrained retaining wall, such as a basement wall, or at restrained wall corners, the at-rest pressure should be used. Passive pressure is used to compute lateral soil resistance developed against lateral structural movement. Further, for sliding resistance, the friction coefficient of 0.35 may be used at the concrete and soil interface. In combining the total lateral resistance, either the passive pressure or the frictional resistance should be reduced by 50 percent. In addition, the passive resistance is taken into account only if it is ensured that the soil against embedded structures will remain intact with time.

In areas where remedial removals may not be possible to provide competent conditions under the footings, the retaining walls should be placed on a deepened footing that extends down into competent native soils. This may be accomplished by either deepening the conventional cantilever footing or providing the wall with caisson and grade beam foundation.

The seismic lateral earth pressure for the level backfill and using a seismic coefficient of 0.15 may be estimated to be an additional 14 pcf for active and at-rest conditions. The earthquake soil pressure has an inverted triangular distribution and is added to the static pressures. For the active and at-rest conditions, the additional earthquake loading is zero at the base and maximum at the top.

3.13 Structural Setbacks

The footings of structures located above descending slopes should be set back from the slope face in accordance with the minimum requirements of the City of Lake Forest and CBC criteria, whichever is greater. The setback distance is measured from the outside edge of the footing bottom along a horizontal line to the face of the slope. For the subject site, the maximum descending slope height is approximately 58 feet.

The table below summarizes the minimum setback criteria for structures above descending slopes:

Structural Setback Requirements for Footings Above Descending Slopes

Slope Height [H] (feet)	*Minimum Setback from Slope face (feet)*
Less than 10	5
10 to 20	½ * H
20 to 30	10
More than 30	⅓ * H (maximum of 40')

Top-of-slope walls (freestanding) or other structures that are sensitive to lateral movement should also comply with these footing setback requirements or be provided with other additional design measures.

3.14 Expansion Potential

The expansion potential of site soils is generally anticipated to range from "very low" to "low" per ASTM D4829 classification. Although some relatively thin clayey siltstone and claystone beds could be of very high expansion potential. At the completion of grading operations, soil samples should be collected at finish grade and tested for expansion potentials to confirm anticipated conditions.

3.15 Concrete in Contact with Soil

The soluble sulfate content for the onsite alluvial soils is within the range of "negligible sulfate exposure" for concrete as classified in Table 4.3.1 of ACI-318. Although the ACI does not require any special concrete design for "negligible sulfate exposure," we recommend that, as a minimum, Type II cement be used even with negligible sulfate exposure. Moreover, we recommend that additional sulfate testing be performed at the site on soils exposed at the surface after grading is complete.

3.16 Surface Drainage

Surface drainage should be carefully taken into consideration during all grading, landscaping, and building construction. Positive surface drainage should be provided to direct surface water away from structures and slopes and toward the street or suitable drainage devices. Ponding of water adjacent to the structures should not be allowed. Paved areas should be provided with adequate drainage devices, gradients, and curbing to reduce run-off flowing from paved areas onto adjacent unpaved areas.

The performance of foundations is also dependent upon maintaining adequate surface drainage away from structures. The minimum gradient within 5 feet of the building will depend upon surface landscaping. In general, we recommend that unpaved lawn and landscape areas have a minimum gradient of 2 percent away from structures immediately adjacent to structures and a minimum gradient of 1 percent for devices such as swales to collect this runoff and direct it toward the street or other appropriate collection points.

3.17 Maintenance of Graded Slopes

To reduce the erosion and slumping potential of the graded slopes, all permanent manufactured slopes should be protected from erosion by planting with appropriate vegetation or suitable erosion protection should be applied as soon as is practical. Proper drainage should be designed and maintained to collect surface waters and direct them away from slopes. The maintenance program should take into account the granular, more erodible nature of the soils that are likely to be present at the slope face at the completion of grading. Consideration should be given to the use of spray-on protective products and frequent use of straw waddles or other temporary runoff control devices immediately after slopes are constructed. In addition, the design and construction of permanent improvements and landscaping should also provide appropriate mitigation measures for sandy soils. A rodent-control program should be established and maintained as well, to reduce the potential for damage related to burrowing.

3.18 Utility Construction

Shoring: Utility excavations should be stabilized per OSHA requirements (shoring or laying back of trench walls) for Type B soils and locally for Type C soils due to possible adverse bedding conditions or loose, running sands.

Pipe Bedding and Sand Backfill: Pipe should be placed on at least 6 inches of clean sand or gravel. The area around the pipe (at least one foot over top of pipe) should be backfilled with clean sand, having a minimum sand equivalent (SE) of 30 or better. The sand could be jetted with water below the springline to ensure filling of voids beneath the pipe (if allowed by local agency). Otherwise, sand along the side of the pipe should be placed in small lifts and compacted with small hand-held compactors (e.g., powder-puffs). Depending on the size of the pipe, higher sand equivalents may be required if jetting is not permitted. Jetting should be performed in moderation to minimize the amount of water introduced into the surrounding native soils.

Trench Backfill: Backfill materials should be moisture-conditioned as needed to within the compactable range and compacted to a minimum relative compaction of 90 percent. Some oversize rocks may be generated from the cuttings from the trenches, if the streets and lots are not overexcavated. These oversize rocks will need to broken down in size or exported from the site. It is anticipated that rocks less than 6 inches in the maximum diameter can be placed in the backfill 2 feet above the pipe zone and 2 feet below subgrade.

Removals within the Borrego Wash and Plain will encounter significant quantities of sand that has a sand equivalent (SE) of 30 or greater, and therefore, may be suitable for structural backfill. Because there are occasional silty layers mixed in with the sand, potential source areas should be evaluated by the geologist/engineer prior to use.

3.19 Geotechnical Review of Future Plans

Future grading plans at 40-scale are expected to be produced for the subject site. These plans will be utilized for rough grading. When these plans are available, a more detailed geotechnical evaluation should be conducted. This additional geotechnical work may include supplementary subsurface investigations, field mapping, and recommendations will be provided that are specific to the grading plans. Specific recommendations for design and construction of foundations, walls and the proposed storm drain system will also be provided based on 40-scale plans and/precise grading plans. A geotechnical report with recommendations for design and construction of these structures will be necessary.

Specific areas of the site that need to be addressed with future more detailed grading plans and subsequent reviews, include but are not limited to the following:

- Detailed plans for the storm drain box structure, slope, and trail areas for the Borrego Wash were not available for review. These plans should be reviewed by the geotechnical consultant for analysis of potential static and dynamic settlement issues when plans become available and prior to construction. The existing boring and CPT data in this area was limited in the depths probed and data gathered and not based on the proposed design. Therefore, additional subsurface data may be necessary to appropriately characterize these materials.

- Three restricted use areas were defined by PSE (2002) on the perimeter of the site. Each of these restricted use areas are reportedly based on unsaturated alluvial/colluvial debris that was left in-place along the property perimeter and were not able to be removed within a 1:1 projection of the proposed project. No subsurface information was available to evaluate the limits, depths or engineering characteristics of the reportedly unsuitable material. In addition

it is possible that the engineering characteristics of these materials may have changed in the past 10+ years since the most recent fill was placed. Therefore, it is recommended that these areas be further investigated using boring and/or trenches to verify the subsurface limits and nature of the soils and to provide updated geotechnical recommendations. The limits of these restricted use areas are also sensitive to the proposed grades. Therefore, these limits need further refining based on the more detailed 40-scale grading plans.

- There is a potential for long-term settlement related to proposed left in place saturated alluvium; deep fills; additional fill placement over existing fills; and additional fill placement over saturated and partially saturated alluvium and old fill. This analysis should be provided once additional data is obtained regarding previous remedial removal bottoms, and should include recommendations regarding specific locations of deep and shallow settlements monuments and plates. This analysis should be provided at the 40-scale plan review stage.

- Current grading of Alton Parkway will result in special conditions that require tying into when the current plan grading is implemented. This includes providing recommendations for subdrain tie-ins, removal geometries, and other anticipated conditions. These details are best provided at the 40-scale plan review stage when Alton Parkway grading is complete.

- Several clay and bentonitic clay beds were noted in borings excavated at the site. These clay beds often form the base of landslides or significantly reduce the stability of slopes which they underlie. Thin clay beds, which are highly or very highly expansive, can also damage building foundations if they are within approximately 10 feet of finished surface grades. It may be prudent during the 40-scale plan review stage to further investigate their character and extent of these clays.

- The natural slopes adjacent to the west side of Borrego Wash range from 5:1 to locally near vertical. These slopes are underlain by granular bedrock, terrace materials, and alluvium. The native earth units are subject to erosion and should be evaluated accordingly at the 40-scale grading plan review stage.

- The natural slope at the northeast corner of the project adjacent to Lot 656 is subject to erosion and possible debris flow. This slope should be evaluated accordingly at the 40-scale grading plan review stage.

3.20 Geotechnical Observation and Testing During Grading

The findings, conclusions and recommendations in this report are based upon interpretation of data and data points having limited spatial extent. These Recommendations should be further updated based upon a review of more detailed 40-scale plans. Verification and refinement of actual geotechnical conditions during grading is also essential, especially where slope stabilization is involved. At minimum, geotechnical observation and testing should be conducted during grading operations at the following stages:

- During and following clearing and grubbing, prior to site processing;

- During demolition of existing structures, foundations or other existing site improvements;

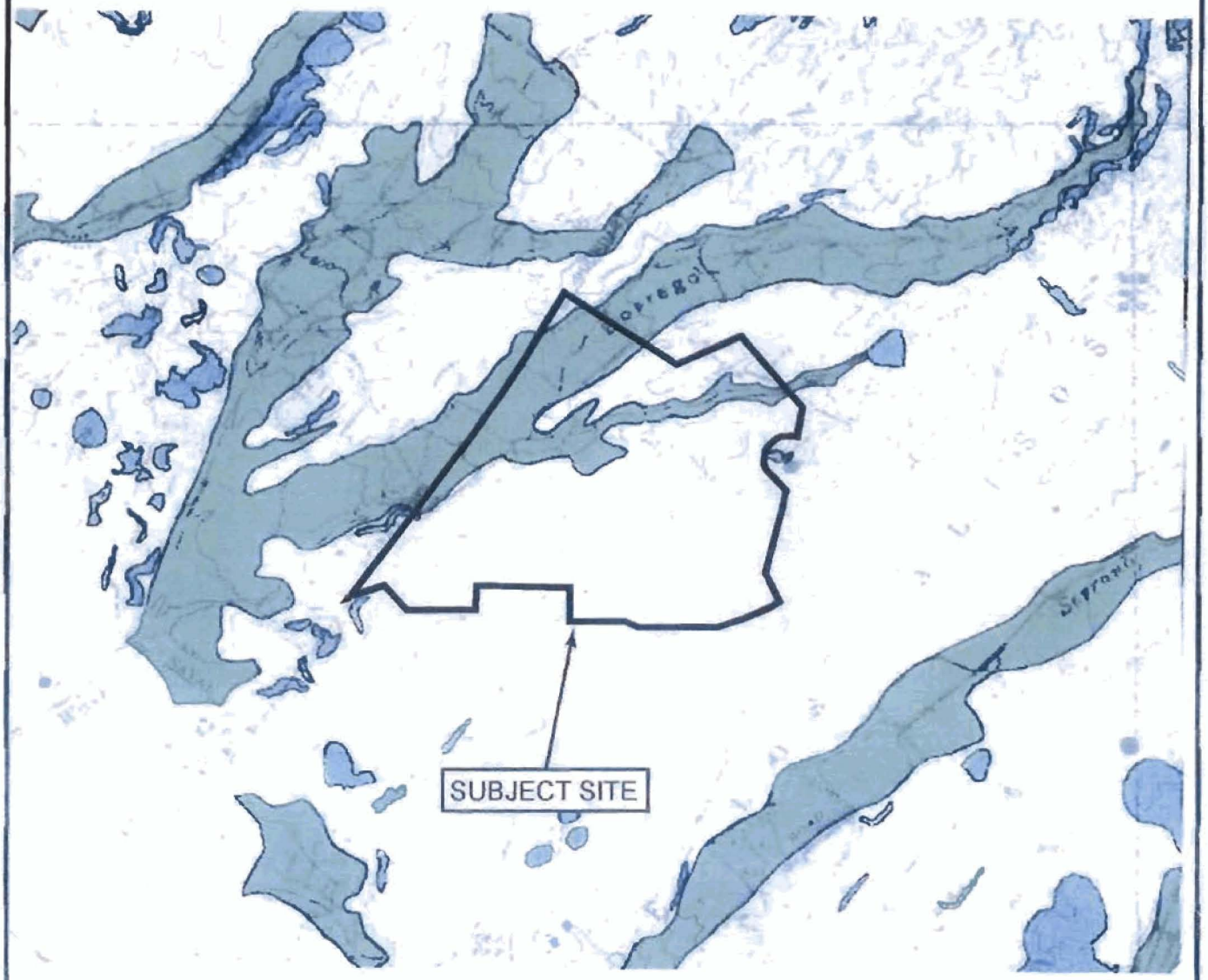
- During and following remedial removals to evaluate the removal bottom;
- During and following cutting of slopes and excavation of slope stabilization measures;
- During installation of subdrains and backdrains;
- During excavation of design cut or transition lots;
- During placement of compacted fill;
- During construction of utility lines (if applicable);
- During and upon completion of excavations for storm drain structures and during trench backfill; and
- When any unusual or unexpected geotechnical conditions are encountered during grading and construction.

4.0 LIMITATIONS

This report has been prepared for the exclusive use of our client, Shea Homes, based on the specific scope of services requested by Shea Homes for the Baker Ranch project described herein. This report or its contents should not be used or relied upon for other projects or by other parties without the consent of NMG and the involvement of a geotechnical professional. The means and methods used by NMG for this study are based in part on local geotechnical standards of practice, care, and requirements of governing agencies. No warranty or guarantee, express or implied is given.

The findings, conclusions, and recommendations are professional opinions based on interpretations and inferences made from geologic and engineering data from specific locations and depths, observed or collected at a given time. By nature, geologic conditions can vary from point to point, can be very different in between points, and can also change over time. Grading and other project plans also are still being developed. Therefore, our conclusions and recommendations are by nature preliminary and are subject to verification and possible modification as plans develop.

Inherently, geotechnical recommendations are also preliminary until the geotechnical consultant observes and tests exposed subsurface conditions during grading and construction. The recommendations in place at that time are subject to modification at the discretion of the geotechnical consultant depending upon exposed geotechnical conditions.



Liquefaction

Areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Earthquake-Induced Landslides

Areas where previous occurance of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

SITE LOCATION AND SEISMIC HAZARDS MAP

BASE: U.S.G.S. SEISMIC HAZARDS MAP,
EL TORO QUADRANGLE
Dated: January 17, 2001

N

BAKE RANCH, TENTATIVE TRACT 16466
CITY OF LAKE FOREST, CA.

Project Number: 10028-01

Project Name: Shea/Baker Ranch

Date: 3-25-11 Figure No. 1

NMG Geotechnical, Inc.

APPENDIX A

APPENDIX A

REFERENCES

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AERIAL PHOTOGRAPHS REVIEWED

Date	*Flight*	*Photograph No.*	*Scale*	*Source*
12/12/1952	AXK	35-37, 74-76		Continental
3/28/1959	261-726	139-142		Continental
9/20/1965	AXK 1FF	73	1:20,000	Continental
3/30/1967	2	105, 106, 132, 133		Continental
7/19/1971	ASL 94	39, 40	1:24,000	Continental
11/21/1972	72202	232, 233		Continental
10/29/1973	132-10	10, 11		Continental
1/13/1975	157	11-14,15 12-15, 16		Continental
1/24/1977	181-11	17, 18		Continental
12/18/1978	203	11-22, 23, 12-23, 24		Continental
2/25/1980	80033	159-161	1"=2,000'	Continental
1/31/1981	211	12-15,16		Continental
4/8/1983	218	12-17, 18	1"=2,000'	Continental
7/26/1988	C-3	205, 206		Continental
1/20/1992	685-11	8, 9	1"=2,000'	Continental
2/2/1993	C89-9	36, 37	1"=2,000'	Continental
1/28/1995	G102-39	97-99	1"=2,000'	Continental
9/11/1997	C116-39	20-23	1"=2,000'	Continental
3/2/1999	C-135-39	155-157	1"=2,000'	Continental
1946-2005	--	--	--	Historic Aerials.com
1994-2009	--	--	--	Google Earth

APPENDIX B

BUCKET AUGER BORING LOGS
BY PSE (2002)

GEOTECHNICAL BORING LOG

PROJECT NO.	500505	PROJECT NAME	BAKER RANCH		
DATE STARTED	3/4/99	GROUND ELEV.	625	BORING DESIG.	B-03E
DATE FINISHED	3/4/99	GW DEPTH (FT)	26.00	LOGGED BY	EMB
DRILLER	DAVE'S DRILLING	DRIVE WT.	VARIES	NOTE	
TYPE OF DRILL RIG	30" BUCKET	DROP	12 in.		

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
	625					SM	FILL (Af): SILTY SAND WITH CLAY, medium brown, moist, slightly dense				
							@ 2' - SILTY SAND, medium to dark brown, moist, slightly dense, asphaltic debris				
5	620	R		2		SM	ALLUVIUM (Qac): SILTY Fine to Medium Grained SAND with trace CLAY, dark brown, moist, loose	4.5	100	18	
						SM/SC	SILTY SAND, trace CLAY with black clay, light brown, moist, medium dense				
						SC	CLAYEY SAND with 1/4" GRAVEL, dark brown to black, moist, medium dense, plastic				
10	615	R		1				15.0	116	94	
							color becomes lighter, micaceous				
15	610						reddish to orangish brown, moist, firm				
20	605	R		1				14.1	105	84	
						SP	Medium to Coarse SAND, trace silt and clay, light brown, moist, dense				
						SC	CLAYEY SAND, dark brown to black, moist, dense				
25	600						becomes grayish brown, mottled, very moist to wet, medium dense to firm				
30	595	R		4		SM	SILTY Fine SAND, dark gray, wet, loose, micaceous	28.6	92	95	
35	590						TOTAL DEPTH = 35 FEET WATER AT 26 FEET CAVING AT 35 FEET HOLE BACKFILLED AND COMPACTED Kelly Bar Wts.: 0 - 27' 4500# 27 - 52' 3500#				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

▼ GROUNDWATER

► SEEPAGE

PACIFIC SOILS ENGINEERING, INC.

PLATE A-3E

GEOTECHNICAL BORING LOG

PROJECT NO. 500505
DATE STARTED 3/4/99
DATE FINISHED 3/4/99
DRILLER DAVE'S DRILLING
TYPE OF DRILL RIG 30" BUCKET

PROJECT NAME BAKER RANCH
GROUND ELEV. 665
GW DEPTH (FT) 46.00
DRIVE WT. VARIES
DROP 12 in.

BORING DESIG. B-04E
LOGGED BY EMB
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
	625	R		6		SP	Coarse SAND, light brown, moist, medium dense	12.8	108	63	
						SC	CLAYEY Fine SAND, trace gravel and cobbles, light brown to orange, moist, dense, micaceous				
						SP	Fine SAND, light brown, moist, dense				
45	620					SC	CLAYEY Coarse SAND, gray to grayish brown, wet, medium dense to dense				
50	615	R		5				18.4	108	92	
							TOTAL DEPTH = 51 FEET WATER AT 46 FEET CAVING AT 47 FEET HOLE BACKFILLED AND COMPACTED Kelly Bar Wts.: 0 - 27' 4500# 27 - 52' 3500# 52 - 80' 2500#				

SAMPLE TYPES:
[R] RING (DRIVE) SAMPLE
[S] SPT (SPLIT SPOON) SAMPLE
[B] BULK SAMPLE [T] TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE

PACIFIC SOILS ENGINEERING, INC.

PLATE A-4E

GEOTECHNICAL BORING LOG

PROJECT NO. 500505
DATE STARTED 3/5/99
DATE FINISHED 3/5/99
DRILLER DAVE'S DRILLING
TYPE OF DRILL RIG 30" BUCKET

PROJECT NAME BAKER RANCH
GROUND ELEV. 697
GW DEPTH (FT)
DRIVE WT. VARIES
DROP 12 in.

BORING DESIG. B-05E
LOGGED BY EMB
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
						SC	TERRACE DEPOSIT (Qt): CLAYEY Fine to Coarse SAND, dark brown, damp, dense				
	695					SM	SILTY Fine to Medium SAND, orange brown with white staining, damp, medium dense to dense, slightly cemented				
5		R		3				3.7	111	20	
	690					SC	CLAYEY Coarse SAND with Gravel and Cobbles, orange brown, moist, dense				
10		R/B		7		SP	GRAVELLY SAND with Clay, light gray, damp to moist, dense	6.6	118	43	CON HY
	685					SM	SILTY Coarse SAND, minor gravel, white and gray, damp to moist, dense				
15							CAPISTRANO FORMATION - OSO MEMBER (Tcq): Fine-Grained SANDSTONE with SILT, gray, damp, dense, micaceous, dark (black) minerals				
	680										
20		R		13				10.8	127	94	
	675										
25							TOTAL DEPTH = 25 FEET NO WATER NO CAVING HOLE BACKFILLED AND COMPACTED Kelly Bar Wts.: 0 - 27' 4500# 27 - 52' 3500# 52 - 80' 2500#				

SAMPLE TYPES:
[R] RING (DRIVE) SAMPLE
[S] SPT (SPLIT SPOON) SAMPLE
[B] BULK SAMPLE [T] TUBE SAMPLE

GROUNDWATER
SEEPAGE

PACIFIC SOILS ENGINEERING, INC.

PLATE A-5E

GEOTECHNICAL BORING LOG

PROJECT NO.	500505	PROJECT NAME	BAKER RANCH		
DATE STARTED	3/5/99	GROUND ELEV.	653	BORING DESIG.	B-06E
DATE FINISHED	3/5/99	GW DEPTH (FT)	42.00	LOGGED BY	EMB
DRILLER	DAVE'S DRILLING	DRIVE WT.	VARIES	NOTE	
TYPE OF DRILL RIG	30" BUCKET	DROP	12 in.		

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
0						SC	FILL (Af): CLAYEY SAND, medium brown, damp, loose, asphalt at surface				
						SC	ALLUVIUM (Qac): CLAYEY SAND with minor gravel, medium gray, laminations of lighter gray to dark brown, damp to moist, medium dense				
	650										
5		R		3				1.7	110	9	
							@ 6' - becomes orange brown, slightly more GRAVEL and COBBLES				
	645						@ 7' - slight increase in clay, color becomes light orange-brown				
10		R		3				5.9	117	38	
	640										
15						SM	SILTY SAND with GRAVEL and COBBLES, trace CLAY, light orange brown, damp, medium dense				
	635										
20		R		4				1.9	107	9	
	630					SM/SC	SILTY SAND to CLAYEY SAND, some Coarse GRAVEL, orange with white laminations/weathering, damp, medium dense				
25						SM	SILTY Coarse SAND with GRAVEL, orange brown, moist, medium dense				
	625					SP	Coarse SAND with gravel and cobbles, orange, damp, dense				
30		R		5				2.0	109	10	
	620					SP/GP	GRAVELLY SAND with some CLAYEY SAND, orange brown, damp to moist, medium dense, boulders				
35											
	615					SC	CLAYEY coarse SAND to SANDY CLAY, dark brown to light black, moist, medium dense/soft, plastic				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

GROUNDWATER

SEEPAGE

PACIFIC SOILS ENGINEERING, INC.

PLATE A-6E

GEOTECHNICAL BORING LOG

PROJECT NO.	500505	PROJECT NAME	BAKER RANCH	BORING DESIG.	B-06E
DATE STARTED	3/5/99	GROUND ELEV.	653	LOGGED BY	EMB
DATE FINISHED	3/5/99	GW DEPTH (FT)	42.00	NOTE	
DRILLER	DAVE'S DRILLING	DRIVE WT.	VARIES		
TYPE OF DRILL RIG	30" BUCKET	DROP	12 in.		

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
		R		2		SC	SILTY to CLAYEY SAND, dark gray, very moist to wet, medium dense, plastic, micaceous	22.8	102	97	
	610					SP	Coarse SAND, orange, moist to very moist, medium dense				
							TOTAL DEPTH = 45 FEET WATER AT 42 FEET CAVING AT 44 FEET HOLE BACKFILLED AND COMPACTED Kelly Bar Wts.: 0 - 27' 4500# 27 - 52' 3500# 52 - 80' 2500#				

SAMPLE TYPES:
- [R] RING (DRIVE) SAMPLE
- [S] SPT (SPLIT SPOON) SAMPLE
- [B] BULK SAMPLE
- [T] TUBE SAMPLE

▼ GROUNDWATER
► SEEPAGE

PACIFIC SOILS ENGINEERING, INC.

PLATE A-6E

GEOTECHNICAL BORING LOG

PROJECT NO.	500505	PROJECT NAME	BAKER RANCH	BORING DESIG.	B-07E
DATE STARTED	3/5/99	GROUND ELEV.	647	LOGGED BY	CED
DATE FINISHED	3/8/99	GW DEPTH (FT)	45.00	NOTE	
DRILLER	DAVE'S DRILLING	DRIVE WT.	VARIES		
TYPE OF DRILL RIG	30" BUCKET	DROP	12 in.		

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
0	645					SM	**TERRACE DEPOSIT (Qt):** SILTY SAND with cobbles, some CLAY, dark brown, damp to moist, medium dense				
						SM	SILTY Fine to Medium SAND with GRAVEL and COBBLES, light red brown, damp, medium dense				
5		R		3				7.5	110	39	
	640										
10		R/B		3		SM	becomes damp to moist	5.2	97	19	CON HY
	635										
15						SP/GP	Medium to Coarse SAND with GRAVEL and COBBLES (to 5"), light brown, damp, medium dense				
	630										
20											
	625										
25		R/B		6			No ring sample recovery due to excessive rock				
	620										
30											
	615					SM	SILTY Fine to Medium SAND with minor GRAVEL (to 1.5"), light red brown, moist, medium dense, slightly micaceous				
		R/B		10		SP	Fine to medium SAND with GRAVEL (to 1.5"), light brown, moist, dense	3.9	106	19	CON HY
35	610						Medium to Coarse SAND with GRAVEL and COBBLES (4" to 6"), moist, medium dense				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

GROUNDWATER

SEEPAGE

PACIFIC SOILS ENGINEERING, INC.

PLATE A-7E

GEOTECHNICAL BORING LOG

PROJECT NO.	500505	PROJECT NAME	BAKER RANCH		
DATE STARTED	3/5/99	GROUND ELEV.	647	BORING DESIG.	B-07E
DATE FINISHED	3/8/99	GW DEPTH (FT)	45.00	LOGGED BY	CED
DRILLER	DAVE'S DRILLING	DRIVE WT.	VARIES	NOTE	
TYPE OF DRILL RIG	30" BUCKET	DROP	12 in.		

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
							more GRAVELLY, more cobbles				
	605					SM	SILTY Fine SAND with CLAY, dark brown to reddish brown, moist to very moist, dense/firm, plastic, micaceous				
						SP					
45		R		3			Medium to Coarse SAND with layers of CLAYEY Fine SAND, gray, very moist to wet, medium dense @ 45' - no sample recovery				
	600										
50							TOTAL DEPTH = 50 FEET WATER AT 45 FEET CAVING AT 47 FEET HOLE BACKFILLED AND COMPACTED Kelly Bar Wts.: 0 - 27' 4500# 27 - 52' 3500# 52 - 80' 2500#				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

▼ GROUNDWATER

► SEEPAGE

PACIFIC SOILS ENGINEERING, INC.

PLATE A-7E

GEOTECHNICAL BORING LOG

PROJECT NO.	500505	PROJECT NAME	BAKER RANCH	BORING DESIG.	B-08E
DATE STARTED	3/8/99	GROUND ELEV.	642	LOGGED BY	EMB
DATE FINISHED	3/8/99	GW DEPTH (FT)	34.00	NOTE	
DRILLER	DAVE'S DRILLING	DRIVE WT.	VARIES		
TYPE OF DRILL RIG	30" BUCKET	DROP	12 in.		

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
0	640					SC	ALLUVIUM (Qac): CLAYEY Medium SAND with minor GRAVEL, red brown to dark brown, damp, loose				
5						SP	Medium to Coarse SAND, medium brown, damp to moist, loose to medium dense				
	635	R		2		SP/GP	GRAVELLY Medium to Coarse SAND, some cobbles, damp to moist, loose to medium dense	12.7	110	66	
						SC	CLAYEY SAND, dark brown to reddish brown with white laminations, moist, medium dense, micaceous				
10		R/B		3				3.8	109	19	
	630					SP/GP	GRAVELLY Medium to Coarse SAND, some cobbles, light to medium brown, damp, slightly to medium dense Very Coarse SAND with GRAVEL, damp to moist				
15											
	625										
20											
	620						Medium to Coarse SAND with GRAVEL, occasional cobbles, medium brown, damp, medium dense				
							SILTY SAND with some CLAY, orangish brown to brown, moist, medium dense				
25		R		3		SM	No sample recovery				
	615	R		7 for 15"			becomes medium brown, micaceous No sample recovery				
30		R		2		SC	CLAYEY Fine SAND, medium brown, moist, medium dense, micaceous, plastic	15.5	112	86	
	610					SP	Coarse SAND with CLAY, gray, wet, medium dense				
							TOTAL DEPTH = 34 FEET WATER AT 34 FEET CAVING AT 34 FEET HOLE BACKFILLED AND COMPACTED Kelly Bar Wts.: 0 - 27' 4500# 27 - 52' 3500# 52 - 80' 2500#				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

▼ GROUNDWATER

► SEEPAGE

PACIFIC SOILS ENGINEERING, INC.

PLATE A-8E

GEOTECHNICAL BORING LOG

PROJECT NO.	500505	PROJECT NAME	BAKER RANCH	BORING DESIG.	B-09E
DATE STARTED	3/8/99	GROUND ELEV.	621	LOGGED BY	EMB
DATE FINISHED	3/8/99	GW DEPTH (FT)	28.00	NOTE	
DRILLER	DAVE'S DRILLING	DRIVE WT.	VARIES		
TYPE OF DRILL RIG	30" BUCKET	DROP	12 in.		

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
0	620					SM	ALLUVIUM (Qac): SILTY SAND, trace CLAY, minor GRAVEL, medium brown, moist, slightly dense				
						SP/GP	GRAVELLY medium to coarse SAND, medium brown to dark gray/black, damp to moist, loose to medium dense, roots, boulder at 3.5 feet				
5	615	R		3				3.0	113	17	
							sand and gravel become more coarse-grained				
10	610	R		3				6.1	108	30	
							GRAVELLY medium to coarse SAND with CLAY				
15	605										
							GRAVELLY medium to coarse grained SAND, lighter brown, damp				
20	600	R/B		4				4.8	108	24	
						SC/CL	CLAYEY SAND to SANDY CLAY, medium brown, damp to moist, medium dense/stiff, plastic				
25	595	B				SC	CLAYEY fine to medium SAND, medium brown, moist, medium dense, slightly micaceous, some fine GRAVEL				
							medium grained CLAYEY SAND, dark brown, becoming more moist				
30	590	R		4			becomes dark brown to dark gray brown with depth	15.6	102	67	
							TOTAL DEPTH = 31 FEET WATER AT 28 FEET CAVING AT 25 FEET HOLE BACKFILLED AND COMPACTED Kelly Bar Wts.: 0 - 27' 4500# 27 - 52' 3500# 52 - 80' 2500#				

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE T TUBE SAMPLE

GROUNDWATER
SEEPAGE

PACIFIC SOILS ENGINEERING, INC.

PLATE A-9E

GEOTECHNICAL BORING LOG

PROJECT NO.	500505	PROJECT NAME	BAKER RANCH	BORING DESIG.	B-10E
DATE STARTED	3/8/99	GROUND ELEV.	606	LOGGED BY	EMB
DATE FINISHED	3/9/99	GW DEPTH (FT)	25.00	NOTE	
DRILLER	DAVE'S DRILLING	DRIVE WT.	VARIES		
TYPE OF DRILL RIG	30" BUCKET	DROP	12 in.		

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
	605					SC	ALLUVIUM (Qac): CLAYEY Fine SAND, medium to dark brown, damp to moist, medium dense, micaceous				
						SP	Coarse SAND with cobbles, light medium brown, damp to moist, slightly dense				
5	600	R		2				2.8	102	12	
						SP/GP	GRAVELLY Coarse SAND, light to medium brown, dry to damp, dense, slightly micaceous				
10	595					SW/GW	Well-graded GRAVELLY SAND with cobbles, light to medium brown, damp, medium dense				
						SP	Fine to Medium SAND with Coarse GRAVEL, light brown, damp to moist, medium dense, minor cobbles				
15	590					SC	CLAYEY Fine Grained SAND, minor gravel, light reddish-brown with white colored weathering, moist, medium dense, slightly micaceous, plastic,				
		B									
20	585	R		2				8.6	106	41	
		B					CLAYEY SAND, very moist, reddish-brown, medium dense				
25	580					SP/GP	GRAVELLY SAND with CLAY, light reddish-brown, wet, medium dense	18.8	107	92	
		R		1							
							TOTAL DEPTH = 29 FEET WATER AT 25 FEET CAVING AT 26 FEET HOLE BACKFILLED AND COMPACTED Kelly Bar Wts.: 0 - 27' 4500# 27 - 52' 3500# 52 - 80' 2500#				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

▼ GROUNDWATER

► SEEPAGE

PACIFIC SOILS ENGINEERING, INC.

PLATE A-10E

GEOTECHNICAL BORING LOG

PROJECT NO.	500505	PROJECT NAME	BAKER RANCH	BORING DESIG.	B-11E
DATE STARTED	3/9/99	GROUND ELEV.	591	LOGGED BY	EMB
DATE FINISHED	3/9/99	GW DEPTH (FT)	23.00	NOTE	
DRILLER	DAVE'S DRILLING	DRIVE WT.	VARIES		
TYPE OF DRILL RIG	30" BUCKET	DROP	12 in.		

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
0	590					SC	ALLUVIUM(Qac): CLAYEY Fine SAND, minor COBBLES, medium to dark gray, damp, medium dense				
						SP	Medium to Coarse SAND with GRAVEL, gray, damp, medium dense				
5	585	R		3				2.7	117	17	
						SP	Fine to Coarse SAND with CLAY, minor gravel, yellowish gray, damp, some GRAVEL				
10	580	R		2				2.9	101	12	
15	575					SP/GP	GRAVELLY Coarse SAND with cobbles, trace CLAY, light to dark brown, damp to moist, medium dense, micaceous				
20	570					SP	Medium to Coarse SAND with SILT, dark brown, damp, medium dense				
						CL	SANDY CLAY, light reddish-brown, moist, soft to medium stiff, micaceous				
						SM	SILTY Coarse SAND with cobbles, some CLAY, light brown, damp, medium dense, cobbles up to 7"				
		R/B		3		SP	Coarse SAND, gray to brown, wet, medium dense	13.0	113	74	
25	565										
							TOTAL DEPTH = 27 FEET WATER AT 23 FEET CAVING AT 23 FEET HOLE BACKFILLED AND COMPACTED Kelly Bar Wts.: 0 - 27' 4500# 27 - 52' 3500# 52 - 80' 2500#				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

▼ GROUNDWATER

► SEEPAGE

PACIFIC SOILS ENGINEERING, INC.

PLATE A-11E

GEOTECHNICAL BORING LOG

PROJECT NO.	500505	PROJECT NAME	BAKER RANCH	BORING DESIG.	B-12E
DATE STARTED	3/29/99	GROUND ELEV.	697	LOGGED BY	EMB
DATE FINISHED	3/29/99	GW DEPTH (FT)		NOTE	
DRILLER	DAVE'S DRILLING	DRIVE WT.	VARIES		
TYPE OF DRILL RIG	30" BUCKET	DROP	12 in.		

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
0	695					SP	ARTIFICIAL FILL (Af): @1' Fine SAND, white, dry to damp, dense, rootlets, micaceous, little gravel				
							White SAND with laminations of CLAY, moist, medium dense, oxidation staining, micaceous				
5		R		1				15.0	114	89	
	690					SC	CLAYEY SAND, medium brown, damp to moist, medium dense				
10		R/B		3		SP	SILTY Fine SAND, gray-blue, moist, medium dense	8.8	114	52	CON MAX DSR EI HY CHEM
	685										
15						SC	CLAYEY SAND, dark gray to black, moist, dense				
	680						CLAYEY SAND, black-brown, moist, dense, laminated, oxidations, rootlets, micaceous, white stains				
20		R		4			CLAYEY Fine SAND, moist, dense, laminated, mottled, little of coarse grained SAND, micaceous, white stains	12.1	121	88	
	675										
25											
	670										
30		R		3		SC	CLAYEY Fine SAND, yellowish-brown, white laminations, moist, dense, pieces of calcium or gypsum	12.1	112	68	CON
	665						becomes black with many roots				
35							CLAYEY SAND gray-blue, moist, dense, micaceous with laminations of Fine SAND with black traces of CLAY, moist, dense				
	660						CAPISTRANO FORMATION, OSO MEMBER (Tco): Very Fine SANDSTONE, very light gray, dense, micaceous				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

GROUNDWATER

SEEPAGE

PACIFIC SOILS ENGINEERING, INC.

PLATE A-12E

GEOTECHNICAL BORING LOG

PROJECT NO. 500505
DATE STARTED 3/29/99
DATE FINISHED 3/29/99
DRILLER DAVE'S DRILLING
TYPE OF DRILL RIG 30" BUCKET

PROJECT NAME BAKER RANCH
GROUND ELEV. 697
GW DEPTH (FT)
DRIVE WT. VARIES
DROP 12 in.

BORING DESIG. B-12E
LOGGED BY EMB
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
	655	R		4			Very Fine Sandstone, very light gray, dense, micaceous	13.8	115	84	
45		R		15/ 10"				11.9	123	92	CON
							TOTAL DEPTH 46 FEET NO WATER, Kelly Bar Wts.: 0 - 27' 4500# 27 - 52' 3500# 52 - 80' 2500#				

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE T TUBE SAMPLE

GROUNDWATER
SEEPAGE

PACIFIC SOILS ENGINEERING, INC.

PLATE A-12E

GEOTECHNICAL BORING LOG

PROJECT NO.	500505	PROJECT NAME	BAKER RANCH	BORING DESIG.	B-13E
DATE STARTED	3/29/99	GROUND ELEV.	580	LOGGED BY	EMB
DATE FINISHED	3/29/99	GW DEPTH (FT)	10.00	NOTE	
DRILLER	DAVE'S DRILLING	DRIVE WT.	VARIES		
TYPE OF DRILL RIG	30" BUCKET	DROP	12 in.		

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
	580					SP	ALLUVIUM (Qac): Fine SAND, light gray to white, damp, loose, roots, micaceous				
						SC	CLAYEY SAND, black, damp, medium dense, roots				
5	575	R		1			CLAYEY Fine SAND, brown, damp, medium dense, rootlets, traces of white, Fine Grained SAND	15.4	115	93	
10	570	R/B		2		SC	CLAYEY Medium SAND, becomes lighter, very moist to wet, slightly dense, micaceous	20.4	107	99	CON
15	565	R/B		PUSH		SP	Medium SAND, light gray, traces of gray CLAY, very wet, medium dense, micaceous, TOTAL DEPTH 16 FEET WATER AT 10 FEET Kelly Bar Wts.: 0 - 27' 4500# 27 - 52' 3500# 52 - 80' 2500#	13.3	113	75	CON

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

▼ GROUNDWATER
► SEEPAGE

PACIFIC SOILS ENGINEERING, INC.

PLATE A-13E

GEOTECHNICAL BORING LOG

PROJECT NO.	500505	PROJECT NAME	BAKER RANCH	BORING DESIG.	B-14E
DATE STARTED	3/29/99	GROUND ELEV.	605	LOGGED BY	EMB
DATE FINISHED	3/29/99	GW DEPTH (FT)	64.00	NOTE	
DRILLER	DAVE'S DRILLING	DRIVE WT.	VARIES		
TYPE OF DRILL RIG	30" BUCKET	DROP	12 in.		

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SATURATION (%)	OTHER TESTS
	605					SP	ARTIFICIAL FILL (Af): Fine SAND with some coarse grains, minor CLAY and SILT, yellow, damp, loose				
							SAND with traces of CLAY, yellow-gray, moist, dense				
							Fine SAND with SILT, CLAY traces, yellow-gray, damp, dense				
5	600	R		3				12.3	119	83	
							more clay, some gravel				
10	595	R		2			Fine SAND with trace cobbles, color becomes very light gray to white, moist, dense	11.5	113	65	
						SM	SILTY SAND with traces of CLAY, gray to dark gray, damp, dense, micaceous and oxidations				
15	590						traces of SILTY CLAY, black, damp to moist, dense				
						CL	SILTY CLAY, dark gray to black, with Fine SAND laminations, damp to moist, firm, micaceous, minor gravel, roots				
20	585	R		2		SC	CLAYEY SAND, light brown, damp to moist, medium dense, some fine gravel, micaceous	11.8	107	58	CON
25	580										
						SP	Fine SAND, very light brown, moist, dense				
30	575	R		6				11.6	118	78	
35	570	B									
						SM	SILTY SAND, dark gray with brown/yellow, damp to moist, dense				
	565										

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

GROUNDWATER

SEEPAGE

PACIFIC SOILS ENGINEERING, INC.

PLATE A-14E

GEOTECHNICAL BORING LOG

PROJECT NO.	500505	PROJECT NAME	BAKER RANCH	BORING DESIG.	B-14E
DATE STARTED	3/29/99	GROUND ELEV.	605	LOGGED BY	EMB
DATE FINISHED	3/29/99	GW DEPTH (FT)	64.00	NOTE	
DRILLER	DAVE'S DRILLING	DRIVE WT.	VARIES		
TYPE OF DRILL RIG	30" BUCKET	DROP	12 in.		

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
	565	R		6							
		R/B		3		SM	Fine to Medium SILTY SAND with some Fine GRAVEL, dark gray to black, moist, dense, traces of CLAY	14.7	117	94	CON
45	560					SC	**ALLUVIUM (Qac):** CLAYEY SAND, gray brown, moist, dense, rootlets becomes dark gray, very moist, soft				
50	555	R		2		SC	CLAYEY SAND, black, some dark green traces, very moist, medium dense, many rootlets, micaceous becomes wet	20.4	107	99	CON
55	550					SM	SILTY SAND, brown, wet, medium dense caving at 56 feet				
60	545	R		9		SP	Fine SAND, light gray, wet, medium dense, micaceous	20.0	107	96	CON
							Water at 64 feet				
65	540	B					TOTAL DEPTH 66 FEET WATER AT 64 FEET CAVING AT 56 FEET Kelly Bar Wts.: 0 - 27' 4500# 27 - 52' 3500# 52 - 80' 2500#				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

GROUNDWATER

SEEPAGE

PACIFIC SOILS ENGINEERING, INC.

PLATE A-14E

ROTARY WASH BORING LOGS
IN PSE REPORT (2002)

TERMS FOR THE DESCRIPTION OF SOIL

MAJOR DIVISIONS			GROUP SYMBOLS	GROUP NAMES
Coarse-grained Soils More than 50% retained on No. 200 sieve	GRAVELS More than 50 % of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines	GW	Well-graded gravel
			GP	Poorly graded gravel
		Gravels with more than 12% fines	GM	Silty gravel
			GC	Clayey gravel
	SANDS 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines	SW	Well-graded sand
			SP	Poorly graded sand
		Sands with more than 12% fines	SM	Silty sand
			SC	Clayey sand
Fine-grained Soils 50% or more passes the No. 200 sieve	SILTS and CLAYS Liquid Limit less than 50	inorganic	CL	Lean clay
			ML	Silt
		organic	OL	Organic clay or silt
	SILTS and CLAYS Liquid Limit 50 or more	inorganic	CH	Fat clay
			MH	Elastic silt
		organic	OH	Organic clay or silt
	Highly Organic Soils		PT	Peat

CONSISTENCY CLASSIFICATION

COARSE-GRAINED SOILS

	Blows/foot (SPT)
Very Loose	<4
Loose	4 to 10
Medium Dense	10 to 30
Dense	30 to 50
Very Dense	>50

FINE-GRAINED SOILS

	Criteria
Very Soft	Thumb penetrates soil > 1 in.
Soft	Thumb penetrates soil 1 in.
Firm	Thumb penetrates soil 1/4 in.
Stiff	Readily indented with thumbnail
Hard	Thumbnail will not indent soil

SOIL MOISTURE

Dry - dry to touch
Moist - damp, but no visible water
Wet - Visible free water

SIZE PROPORTIONS

Trace - < 5 %
Few - 5 to 10 %
Some - 15 to 25 %

LABORATORY TESTS

DS	Direct Shear
DSR	Direct Shear (Remolded)
CON	Consolidation
SA	Sieve Analysis
MAX	Maximum Density
RV	Resistance Value
EI	Expansion Index
SE	Sand Equivalent
AL	Atterberg Limits
CHEM	Chemical Analysis
HY	Hydrometer Analysis

GEOTECHNICAL BORING LOG

PROJECT NO. 500505G
DATE STARTED 9/13/02
DATE FINISHED 9/13/02
DRILLER Gregg
TYPE OF DRILL RIG Rotary Wash

PROJECT NAME Borrego Wash
GROUND ELEV. +653
GW DEPTH (FT)
DRIVE WT. 140 lb.
DROP 30 inch

BORING DESIG. RW-1
LOGGED BY TJM
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
						SM	ALLUVIUM/COLLUVIUM (Qac): SILTY SAND, brown, dry, loose				
		R		5/5/7				5.3	105	24	
5		S		3/4/4							HY
		R		9/10/11		SP	SAND, light brown, damp, medium dense	3.9	116	24	DS HY
						SP	SAND, light brown, damp, medium dense				
10		S		7/10/9			CAPISTRANO FORMATION OSO MEMBER (Tco): SANDSTONE, white, moist, very hard, micaceous				
		R		12/30/41			TOTAL DEPTH 12½ FEET NO WATER ENCOUNTERED	16.1	111	85	
		S									
		R									
		S									
		R									
		S									

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE T TUBE SAMPLE

▼ GROUNDWATER
► SEEPAGE
B: BEDDING
S: SHEAR
J: JOINT

PACIFIC SOILS ENGINEERING, INC.

PLATE RW-1

GEOTECHNICAL BORING LOG

PROJECT NO.	500505G	PROJECT NAME	Borrego Wash	BORING DESIG.	RW-2
DATE STARTED	9/13/02	GROUND ELEV.	+628	LOGGED BY	TJM
DATE FINISHED	9/13/02	GW DEPTH (FT)		NOTE	
DRILLER	Gregg	DRIVE WT.	140 lb.		
TYPE OF DRILL RIG	Rotary Wash	DROP	30 inch		

DEPTH (Feet)	SAMPLE TYPE	SAMPLE	BLOWS	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
	R		6/6/8	ML	ALLUVIUM/COLLUVIUM (Qac): fine grained SANDY SILT, brown, damp, firm	8.1	114	47	
5	S		3/4/4	SM	SILTY SAND, reddish-brown, damp, loose				HY
	R		4/8/9	SM	SILTY fine grained SAND, brown, damp, medium dense	12.3	108	61	
10	S		3/4/3	SM	SILTY fine grained SAND, brown, damp, loose				
	R		5/10/10	SM	SILTY fine to coarse-grained SAND, with gravel and pebbles, brown, damp, medium dense	10.7	109	54	
15	S		3/6/8	SP	Fine to coarse-grained SAND, with gravel and pebbles, brown, damp, medium dense				HY
	R		4/17/13	SM	SILTY fine to coarse-grained SAND, with gravel, brown, damp, medium dense to dense	12.3	112	68	DS HY
20	S		12/18/18	SP	@ 20 ft. - pebbles and gravel, brown, moist, dense				HY
	R		4/30/50 for 4"	GP	Gravel, pebbles, coarse SAND, brown, moist, dense	8.0	128	72	
25	S		5/13/13						HY
	R		16/18/19			8.4	128	74	
30	S		6/13/10	GP ▶	gravel and coarse-grained SAND, wet, medium dense, seepage				HY
	R		12/16/13		@ 32 ft. - no recovery - predominantly gravel and pebbles				
35	S		6/8/9	SP	Medium grained SAND, brown, wet, medium dense				HY
	R				@ 37 ft. - rocks from above @ 32 ft. are falling into the boring, sampler bouncing, No recovery				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

▼ GROUNDWATER
▶ SEEPAGE
B: BEDDING
S: SHEAR
J: JOINT

PACIFIC SOILS ENGINEERING, INC.

PLATE RW-2

GEOTECHNICAL BORING LOG

PROJECT NO.	500505G	PROJECT NAME	Borrego Wash		
DATE STARTED	9/13/02	GROUND ELEV.	+628	BORING DESIG.	RW-2
DATE FINISHED	9/13/02	GW DEPTH (FT)		LOGGED BY	TJM
DRILLER	Gregg	DRIVE WT.	140 lb.	NOTE	
TYPE OF DRILL RIG	Rotary Wash	DROP	30 inch		

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
							@ 40 ft. - could not advance the sampler- bent hole rocky drilling @ 41 ft. -could not advance the sampler- bend hole, rocky drilling				
45							CAPISTRANO FORMATION OSO MEMBER (Tco) @ 45 ft. - probably bedrock, a little harder, no rocks, smooth, firm drilling				
							@ 49 ft. - still can not get sampler past 40' @ 50 ft. - smooth, firm drilling				
50											
55							CLAYEY SILTSTONE on teeth of drill bit, green gray				
		S	21	48/50 for 2"			SILTY SANDSTONE, dark green gray, micaceous, damp, very hard TOTAL DEPTH 58 FEET SEEPAGE @ 30 FEET CAVING @ 40 FEET				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE T TUBE SAMPLE

GROUNDWATER
SEEPAGE
B: BEDDING
S: SHEAR
J: JOINT

PACIFIC SOILS ENGINEERING, INC.

PLATE RW-2

GEOTECHNICAL BORING LOG

PROJECT NO.	500505G	PROJECT NAME	Borrego Wash	BORING DESIG.	RW-3
DATE STARTED	9/13/02	GROUND ELEV.	+608	LOGGED BY	TJM
DATE FINISHED	9/13/02	GW DEPTH (FT)		NOTE	
DRILLER	Gregg	DRIVE WT.	140 lb.		
TYPE OF DRILL RIG	Rotary Wash	DROP	30 Inch		

DEPTH (Feet)	SAMPLE TYPE	SAMPLE	BLOWS	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
				SM	SILTY SAND, green gray, damp, very loose, peat moss, debris				
	S		2/2/2						
5	R		Push	SC	poor recovery - 3 rings disturbed, CLAYEY SAND, greenish brown, damp, very soft				
	S		1-/0/0	SM	plastic sod webbing in SILTY SAND, loosing water				
10	R		Push	SM	SILTY SAND, dark greenish brown, damp, very soft	20.7	101	86	DS HY
15					@ 17 ft. - some resistance, still loosing water				
	S		2/4/5	SM	ALLUVIUM/COLLUVIUM (Qac): SILTY fine grained SAND, tan, dry, very loose to loose				HY
20	R		10/27/44	SP	@ 22 ft. - coarse-grained SAND, with gravel, damp, hard, (still loosing water)	6.3	128	56	
25					@ 25 ft. - try to drill to bedrock before water runs out				
30									
35									

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE T TUBE SAMPLE

GROUNDWATER
SEEPAGE
B: BEDDING
S: SHEAR
J: JOINT

PACIFIC SOILS ENGINEERING, INC.

PLATE RW-3

GEOTECHNICAL BORING LOG

PROJECT NO. 500505G
DATE STARTED 9/13/02
DATE FINISHED 9/13/02
DRILLER Grego
TYPE OF DRILL RIG Rotary Wash

PROJECT NAME Borrego Wash
GROUND ELEV. +608
GW DEPTH (FT)
DRIVE WT. 140 lb.
DROP 30 inch

BORING DESIG. RW-3
LOGGED BY TJM
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT. URATION (%)	OTHER TESTS
45							@ 45 ft. - continuous lithology, loosing water	21.2	100	84	
50											
55							@ 55 ft. - continuous lithology, loosing water				
							TOTAL DEPTH 58 FEET lost water				

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE T TUBE SAMPLE

GROUNDWATER
SEEPAGE
B: BEDDING
S: SHEAR
J: JOINT

PACIFIC SOILS ENGINEERING, INC.

PLATE RW-3

GEOTECHNICAL BORING LOG

PROJECT NO. 500505G
DATE STARTED 9/16/02
DATE FINISHED 9/16/02
DRILLER Gregg
TYPE OF DRILL RIG Hollow stem

PROJECT NAME Borrego Wash
GROUND ELEV. +602
GW DEPTH (FT) 28
DRIVE WT. 140 lb.
DROP 30 inch

BORING DESIG. RW-4
LOGGED BY TJM
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
							ALLUVIUM/COLLUVIUM (Qac): SILTY fine grained SAND, brown, dry to damp, very loose to loose				
		R		7/8/10		SM	SILTY fine grained SAND, brown, dry to damp, medium dense	4.3	102	18	
5		S		3/3/3							HY
		R		7/8/10		ML	Fine grained SANDY SILT, yellow tan, dry to damp, firm	11.7	105	53	
10		S		5/4/4		SP	SAND, some gravel, yellow tan, loose				HY
		R		3/8/12		ML	CLAYEY SILT, brown, damp, firm	18.4	103	80	
15		S		4/5/6		SM	SILTY SAND, yellow brown, interstratified SANDY SILT, brown, damp, loose to medium dense				HY
		R		5/7/7			SILTY SAND, yellow brown, dry to damp, medium dense	11.0	105	50	
20		S		5/6/9		SM	SILTY SAND, yellow brown, dry to damp, medium dense				HY
		R		12/13/15		SM	SILTY SAND, with gravel, yellow brown, dry to damp, moderate to medium dense	2.7	111	15	
25		S		7/10/14		SP	Fine to medium grained SAND, with gravel, yellow brown, dry to damp, medium dense				HY
		R		12/20/35		SP	▼ Slight seepage from SILTY coarse-grained SAND, yellow brown, wet, very dense	8.2	110	43	
30		S		9/14/16		SP	Fine to medium grained SAND, light brown, wet, saturated, medium dense to dense				HY
		R		26/27/23			Coarse-grained SAND, light brown, saturated,, dense to very dense	8.1	131	80	
35		S		9/10/16		SP	Medium grained SAND, light tan, saturated, medium dense				HY
		R		23/50			SILTY medium to coarse-grained SAND, gray tan, saturated, very dense	13.1	119	87	HY

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE T TUBE SAMPLE

▼ GROUNDWATER
► SEEPAGE
B: BEDDING
S: SHEAR
J: JOINT

PACIFIC SOILS ENGINEERING, INC.

PLATE RW-4

GEOTECHNICAL BORING LOG

PROJECT NO.	500505G	PROJECT NAME	Borrego Wash	BORING DESIG.	RW-4
DATE STARTED	9/16/02	GROUND ELEV.	+602	LOGGED BY	TJM
DATE FINISHED	9/16/02	GW DEPTH (FT)	28	NOTE	
DRILLER	Gregg	DRIVE WT.	140 lb.		
TYPE OF DRILL RIG	Hollow stem	DROP	30 inch		

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
		S		7/10/8		SC	CLAYEY medium grained SAND, light grayish tan, saturated, medium dense				HY
		R		11/17/20		SM	SILTY medium grained SAND, light grayish tan, saturated, dense, (no recovery)				
45		S		7/6/5		SP	Fine to coarse-grained SAND, light gray tan, saturated, very loose to loose				HY
		R		13/25/47		ML	Very fine grained SANDY SILT, light tan, saturated, hard	15.6	116	95	
50		S		5/13/18			CAPISTRANO FORMATION OSO MEMBER (Tco): SILTY SANDSTONE, tanish gray, moist, moderately hard, micaceous				HY
							TOTAL DEPTH 51 FEET				
							WATER @ 27½ FEET				

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE T TUBE SAMPLE

GROUNDWATER
SEEPAGE
B: BEDDING
S: SHEAR
J: JOINT

PACIFIC SOILS ENGINEERING, INC.

PLATE RW-4

GEOTECHNICAL BORING LOG

PROJECT NO.	500505G	PROJECT NAME	Borrego Wash	BORING DESIG.	RW-5
DATE STARTED	9/16/02	GROUND ELEV.	+616	LOGGED BY	TJM
DATE FINISHED	9/16/02	GW DEPTH (FT)		NOTE	
DRILLER	Grego	DRIVE WT.	140 lb.		
TYPE OF DRILL RIG	Hollow stem	DROP	30 inch		

DEPTH (Feet)	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION
0	SM	ALLUVIUM/COLLUVIUM (Qac): SILTY fine grained SAND, light orange tan, dry to damp, loose
5		
		@ 8 ft. - rocks
10	SM	@ 10 ft. - hard drilling - rocks in sand matrix SILTY fine grained SAND, light orange tan, damp
	SP	medium to coarse-grained clean SAND, light orange tan, damp to moist
15	SP	medium to coarse-grained clean SAND, light orange tan, damp to moist
20	SM	SILTY medium grained SAND, yellow brown, damp to moist
25	SM	SILTY fine to coarse-grained SAND, yellow brown, damp, micaceous, very coarse-grained lithics and few gravel
		@ 27 ft. - hard drilling on rocks
		TOTAL DEPTH 27 FEET REFUSAL ON HARD ROCKS NO WATER

MOISTURE CONT (%) | DRY (pcf) DENSITY | SAT-URATION (%) | OTHER TESTS

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

GROUNDWATER
SEEPAGE
B: BEDDING
S: SHEAR
J: JOINT

PACIFIC SOILS ENGINEERING, INC.

PLATE RW-5

GEOTECHNICAL BORING LOG

PROJECT NO.	500505G	PROJECT NAME	Borrego Wash	BORING DESIG.	RW-6
DATE STARTED	9/16/02	GROUND ELEV.	+622	LOGGED BY	TJM
DATE FINISHED	9/16/02	GW DEPTH (FT)	34	NOTE	
DRILLER	Gregg	DRIVE WT.	140 lb.		
TYPE OF DRILL RIG	Hollow stem	DROP	30 inch		

DEPTH (Feet)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
						SM	ALLUVIUM/COLLUVIUM (Qac): SILTY fine to medium grained SAND, yellow tan, damp, common coarse-grained lithics, some gravel				
10							@ 10 ft. - continuous lithology as above at surfaced				
15							@ 17 ft. - few pebbles				
25							@ 25 ft. - continuous lithology				
34							▼ @ 34 ft. - groundwater				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
B: BEDDING
S: SHEAR
J: JOINT

PACIFIC SOILS ENGINEERING, INC.

PLATE RW-6